

QUARTERLY PROGRESS REPORT
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July 2004 – September 2004

Marshall Space Flight Center
Safety and Mission Assurance Mission Services Contract
NAS8-00179

Approved:

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1.0 INTRODUCTION

Hernandez Engineering, Inc. (HEI) successfully performed all required activities and tasks, as described in this report, in fulfillment of their Safety and Mission Assurance (S&MA) Mission Services Contract (NAS8-00179) with NASA's Marshall Space Flight Center (MSFC). This report covers a three-month period of the contract's fourth quarter of the third option year: July 2004 through September 2004.

2.0 GENERAL MANAGEMENT

2.1 Data Requirements


The fourth quarter of the third option year of the S&MA Mission Services contract was successfully completed on September 26, 2004. All Data Requirements (DR) Documents were submitted on or ahead of schedule throughout the quarter. They included DRD 875CD-001 On-Site Employee Location Listing; DRD 875MA-002 Financial Management Reports; DRD 875MA-003 Progress Reports (Monthly/Quarterly); DRD 875MA-006 Operations Plan, Problem Assessment Center (PAC); DRD 875MA-007 Quarterly Open Problems List; DRD 875MA-008 Monthly Newly Opened/Closed Problem Summary; DRD 875SA-002 Mishap and Safety Statistics Reports; and Quarterly Safety Performance Evaluation.

2.2 Personnel Status

(b)(4)

3.0 BUSINESS MANAGEMENT

We have experienced no financial or business management problems during this period. We attribute this to close attention to details, effective use of established controls designed to efficiently respond to program changes---both anticipated and unexpected---and the continuing support of our corporate financial group's dedicated efforts at controlling overhead expenses.

The contract continues to have a total cost under-run at the end of this period---see the September 2004 Monthly Financial Report, DRD 875MA-002, for specifics. Attachment 2, Man-Hours Expended, of this report contains a description, by major task, of the total man-hours expended this period. 

(b)(4)

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4.0 PERFORMANCE OF WORK AND USE OF FACILITIES AND EQUIPMENT

4.1 Safety

4.1.1 Industrial Safety (IS)

The Industrial Safety (IS) group performed 90 OSHA compliance annual facilities inspections and provided all required reports in a timely manner. Also, IS performed 463 construction site compliance inspections to monitor adherence to OSHA and MSFC safety standards. All facility safety violations were documented in the SHEtrak database in order to assure MSFC's compliance with OSHA, NASA, and other consensus code requirements.

Among other activities, IS: (1) participated in nine final safety inspections of facilities under renovation or construction; (3) reviewed 57 sets of facility design drawings for compliance with OSHA and consensus codes; (4) assisted the Industrial Safety Department (ISD) develop and process, for web page

posting, four Safety Bulletins and three Shop Talk safety information topics; (5) taught two training sessions to supervisors on how to perform monthly workplace safety visit inspections; and, (6) performed 10 annual fire drills.

Although not a designated contract year Area of Emphasis (AOE), IS agreed to continue the emphasis to increase awareness of identifying Unsafe Acts in the workforce. IS identified four Unsafe Acts with emphasis on on-the-spot corrections and prepared numerous general safety awareness communication messages for ISD to distribute to Center employees. To assist in this effort HEI continued to provide an experienced senior Industrial Safety engineer to assist the ISD identify Unsafe Acts. In addition, this same part-time employee surveyed 264 locations to assure adherence to Lockout/Tagout requirements when working on energized systems and monitored construction and maintenance activities, which included spot checks during after normal work hours and weekends.

IS continued to provide (b) (4) to assist the SHE Communications and Training Teams and general communication of safety awareness to all MSFC employees. Assistance included: (1) prepared and processed, for web page posting, the weekly SHE highlights and monthly SSWP safety required and optional focus topics; (2) prepared monthly SHE communications plans; (3) developed multiple innovative safety awareness communications materials including safety announcements on MSFC TV; (4) continued to assist the SHE Committee Chairperson and ISD support bimonthly SHE Committee meetings, including collection and organization of pre-meeting briefing charts, serving as recorder, and preparing draft meeting minutes (twice monthly); and, (5) in support of a new S&MA Technical Directive, HEI initiated additional administrative and technical support to the SHE Committee to assist with annual SHE Program annual progress reports and tracking of SHE actions. Also, to assist in documenting and tracking SHE Committee and external SHE Program evaluation action items, IS coordinated with the HEI IM Group to plan and initiate development of a new S&MA database, SHE Committee Action Item Tracking System (SHECAITS). In support of the additional effort required to support the SHE Program, HEI self-initiated hiring an additional employee for the IS team to assist with these new requirements.

IS initiated, completed or followed-up on more than ten hazard analyses. Examples include: (1) completed a Safety Assessment (SA) for the 24-Inch HPGT Motor test at TS500; (2) completed a SA for the AF-M315 Monopropellant Hot-Fire Testing at TS115; (3) completed an Operational Hazard Analysis (OHA) for the Orbiter Boom System (OBSS)/Inspection Boom Assembly (IBA) transportation and handling operations at MSFC; and, (4) continued to perform SA's for the new high visibility Propulsion Research Laboratory (PRL), which began beneficial occupancy in May, 2004.

IS continued to support the implementation of the NASA lifting standard, NASA-STD-8719.9 by providing day-to-day advice and assistance to S&MA customers. IS advised civil service and contractor managers, supervisors and employees on requirements for lifting equipment usage in support of the MSFC SHE Program. In addition to an OHA for the lifting devices used to support the OBSS/IBA testing in building 4619, IS served as the on-site safety move monitor for the lifting and handling operations associated with the multiple tests. HEI completed a Critical Lift Overhead Crane Certification Package, which included a FMEA, for the newly refurbished cranes in building 4755. Also, IS continued to be an active participant in the Lifting Device Equipment (LDE) SHE subcommittee. In support of the task to administer proficiency exams to civil service and contractor operators of overhead cranes, fork lifts, small truck mounted hoists, and aerial lifts, IS administered hands-on proficiency examinations to four overhead crane and five forklift operators in support of the MSFC Personnel Certification Program.

As a continued significant strength, IS continued to provide (b) (4) support to the MSFC Test areas. Examples of support included: (1) reviewed and approved multiple operating and test procedures for hazardous operations; (2) calculated the Quantity - Distance (QD)

requirements for the AF-M315 Monopropellant Hot Fire Testing at TS 115; (3) assisted in upgrading the TS 115 Area Control Procedure; (4) monitored and supported the test firing of the 24-Inch NC-5 Motor; (5) actively participated in daily and weekly safety meetings/safety stand downs of Test and Evaluation Department, Space Transportation Directorate; (5) as an additional duty, served as the alternate safety representative for test area facilities; and, (6) provided daily support to test engineers and S&MA personnel on technical issues to include performing numerous test procedure reviews.

IS team members continued to maintain currency in all safety areas; e.g., attended the DoD Explosives Seminar, Alabama Governor's Safety Conference, and multiple training session offered by the NSTC. With the recent Center's decision to contract with STAR Consultants, Inc to perform an independent third party SHE assessment, two IS employees attended the VPPPA training conference.

4.1.2 System Safety Engineering

System Safety Engineering (SSE) completed development and incorporation of all inputs to the S&MA Handbook for Programs and Projects. Several draft versions were generated and reviewed by multiple disciplines with increasing scrutiny. The handbook was delivered on 09/27/04 to QD10 management for final review and comment. Afterwards the final comments will be incorporated and it will be submitted to QD01 for final approval.

SSE continued supporting for the Human Rated Launch Vehicle (HRLV) System Requirements draft development. SSE acted as the lead & POC for S&MA (RFT 0007.04). The results were presented to and well received by QD01, Mr. Roy Malone, and QD10 personnel. SSE support continued with the development of the draft level 1 Constellation requirements, roadmap for open work resolution, mapping the Level 1 requirements to the System Requirements Document (SRD) and the Super System Draft Requirements. Additional efforts included reviewing and commenting to Serial 1/2/3 technical and programmatic requirements. The validation of the draft SRD remains as the only identified task to complete.

SSE coordinated the S&MA review of NPR 8705.2 and compiling of comments. Comments were delivered 09/24/04 to QD10 personnel with an attached signature memo.

SSE was assigned the task to develop documents supporting future Constellation S&MA efforts on 09/01/04. SSE led the development of the System Safety Program, Hazard Analysis Methodology, Fault Tree Analysis Methodology and Software Safety Fault Analysis Methodology as well as a primary contributor to the S&MA Plan. The final documents were delivered on 09/15/04.

SSE developed inputs to the Work Breakdown Structure (WBS) for five (5) new proposed projects that MSFC will be participating in. The supplied information included draft WBS statements describing the safety tasks necessary for each proposed project and supporting justification for each statement. SSE also submitted additional notes where necessary to ensure full safety coverage of complex proposed systems.

SSE reviewed and commented on the Fault Tree Analysis which considered the loss of the Jupiter Icy Moons spacecraft during the coast phase.

System Safety Engineering participated in the development of presentation material for the SSP S&MA Manager's (Col. Nancy Currie) presentation to the NASA Administrator the status of the SSP Hazard Analysis for Return-To-Flight. SSE developed Hazard Status charts for each of the MSFC Elements based on inputs from the projects. SSE also developed three example charts of on-going changes to specific Hazard Reports including External Tank Report, T.02, Loss of TPS; Solid Rocket Booster Reports B-60-12, Debris Impacts ET or Orbiter and C-30-01, Inability to Successfully Separate from the Space Shuttle Vehicle Leads to Re-contact.

SSE participated in Shuttle Safety Review Panel (SSRP) meetings as the MSFC S&MA SSRP representative. A pre-meeting was held on 07/14/04 with RSRM S&M on RSRM Inactive Stiffener Stub TPS Redesign. A pre-meeting telecon was held on 07/28-29/04 with ET S&MA to discuss the CIL items (243 Aerodynamically Sensitive Items (ASI) FMEA/CILs) and HR S.11, ET Structural System Debris & HR E.04, Malfunction of Bipod Heaters on ET.

SSE participated in a series of discussions concerning potential Common Cause Failure (CCF) mode evaluations for the Space Shuttle return-to-flight (RTF). SSE supported a RTF team telecon and the resulting activity to develop a CCF checklist to use to evaluate Space Shuttle CCF considerations.

System Safety Engineering has been supporting and coordinating the following ET RTF activities: Accepted Risk Hazard Report Review, Controlled Risk Hazard Report Review, and Critical Items List (CIL) Review activities at MAF and MSFC. Additionally, SSE is supporting FTA and integration tiger teams and coordinating with the SSRP, and Shuttle Change Control Board.

SSE supported the CDR for the Return-To-Flight Intertank/LH2 Tank Flange. SSE reviewed current documentation including fault trees, Safety Assessments and Hazard Analyses before traveling to Michoud Assembly Facility. SSE worked several issues with the responsible System Safety Engineering staff at Michoud. All recommendations & comments were accepted and a RID was not required as the documentation was changed during the review. This activity was accomplished during the period of 8/29 – 9/3/04.

SSE has begun to analyze the safety aspects of the ET Excitation Power Box (EPB) and wrote the System Safety portion of the Safety and Mission Assurance Plan for the EPB. SSE developed a Preliminary Hazard List; a forwarded question related to the design to engineering based on the initial analysis and continues to perform hazard analysis of the EPB.

System Safety Engineering supported the Reinforced Carbon-Carbon (RCC) On-orbit Crack Repair (ROCR) project by reviewing and commenting to the Project Technical Requirements Specification (PTRS), participating in the scheduling review, providing information and organizing the TVS and Off-gas Testing required supporting the Dual Glovebox testing. A material has been down selected based on those test results.

SSE has begun to plan the human rated HTV testing that is to occur at JSC as part of qualifying the Crack Repair Material (CRM) for the ROCR project. Toxicity and thermal vacuum stability results will need to be provided to the HTV project to clear the facility for crew use. SSE is coordinating a SMART board review and three phased safety reviews at JSC with the project.

Safety Engineering (SSE) provided support to the Reinforced Carbon-Carbon (RCC) On-Orbit Crack Repair (ROCR) Project material down-select process. The team has selected a primary material and secondary material to use for repair. The Preliminary Design Review (PDR) is scheduled for 10/13-15/04 at Marshall Space Flight Center. SSE will prepare a presentation of crack repair material hazards for the PDR.

System Safety Engineering participated in discussions concerning aft stiffener ring criticality, ply lifting, and transport from ATK Utah to KSC (via rail) of the segment and nozzle. ATK developed an outline of the transportation process, with reference to CIL (FMEA, Hazard) requirements. The RSRM group at MSFC reviewed and accepted the layout process as presented.

SSE participated in discussions concerning Aft End Cone shim protrusion allowance, ply lifting, set screw item, the RSRM STS-114 Project Milestone Acceptance Review, Flight Support Motor (FSM) 12 use of a 30 degree wrap carbon phenolic aft end cone and silicon contamination on squeegees. ATK Thiokol wants to use a nozzle wrapped at 30 degrees on FSM 12 (which had the separation problem during wrap) to try and reduce or eliminate ply lifting.

SSE supported and participated in the Ply lifting TIM held at MSFC 09/08-09/04 to address concerns with the proposed plans. SSE also supported meeting to address the Physics Based Analysis of Ply Lifting, the Fail/Safe Analysis related to thermal and structural effects of ply lifting, and Flight Rationale for the continued use of the current baselined (NARC) material for flight nozzles, as well as those nozzles already built using the baselined material. Currently there is enough NARC material stockpiled to build nozzles to support the current launch schedule through 2010 (fleet retirement). Much of the discussion was addressing the proposed replacement material (ENKA), and its performance characteristics.

SSE also supported the RSRM S&MA lead in the CERB meetings; continued supporting RSRM Inactive Stiffener Stub Closeout redesign activity held at Marshall Space Flight Center and integrated tiger team activity. The tiger team activity consisted of a telecom discussion of the SRB/SRM Interface hazards Analysis Plan. SSE is reviewing an approach and a draft fault tree drafted by USA and plans to provide comments.

SSE participated in discussions concerning RSRM inline configuration for human rated shuttle derived systems. These discussions centered around getting information related to hazard/failure modes and trying to get a handle on preliminary probability of events leading to failure. ATK provided some initial probable single RSRM failure modes, based on the RSRM Hazard Reports. This is the very preliminary stage of a larger effort to look at launch platform alternatives.

SSE provided a status for the single remaining open SRB Accepted Risk for BSM Debris Liberation hazard. Ten Accepted Risks were reviewed and accepted by the SSRP on 05/19/04. The remaining accepted risk is related to the BSM debris generation sources from the cracked throat problem and unfinished BSM plume characterization and the results of the Transport Analysis which is supposed to predict debris impact paths. SSE has reached an agreement with USA on a methodology for review of all annual changes, hazard reports and Fault Tree Analysis. Currently 50% of the work has been completed. The estimated completion date of these tasks is 10/22/04.

SSE participated in five (5) SSME teleconferences reviewing project status, technical issues, system safety and reliability. SSE participated in a three-day review of nine (9) Accepted Risk Hazard Reports on 08/03/04 through 08/05/04 at Canoga Park, CA, and follow-on discussions relative to Pratt & Whitney's proposed rationale for downgrading two (2) of their Accepted Risk hazard causes. The SSE identified several technical corrections plus numerous editorial changes that were needed in the Hazard Report for the high pressure oxidizer turbopump (HPOTP). The proposed changes were concurred with by the group, and will be incorporated prior to release for MSFC approval. SSE also completed evaluation of three (3) SSME changes and ten (10) System changes. All changes were approved, some with modification.

SSE participated via teleconference in the 09/09/04 "kickoff" meeting of the SSME/Orbiter Liquid Nitrogen (LN2) Evaluation Team. The team is working to identify the potential SSME and Orbiter sources of liquid nitrogen in the Orbiter's aft compartment, to identify which critical components in that area may be susceptible to LN2 impingement, and to determine whether this potential hazard cause is adequately controlled. Action items to accomplish those tasks were assigned to various members of the team, additional meetings are planned to review action item status and discuss required additional work.

SSE reviewed a preliminary spreadsheet of SSME hazard report references associated with Space Shuttle Electrical Power Distribution and Control (EPD&C). The spreadsheet was generated by Boeing-Rocketdyne in response to an action item from the Integration hazard report EPD&C working group. Several suggestions for changes were provided by SSE, which were incorporated by Boeing-Rocketdyne into the spreadsheet before it was transmitted to the working group. The SSME action for that hazard report was therefore closed. A similar process will be followed for the other integrated hazard reports to identify the SSME hazard reports, CILS, or other documents that must be referenced in the various integrated hazard reports.

SSE supported the weekly NODE 2/3 team meetings. SSE reviewed 12 document changes for impacts to Node 2/3; only two (2) changes have direct S&MA impact to the Nodes. Change CR7964 was accepted and CR8729A continues to be reviewed for impacts.

SSE supported a telecon to discuss the hatch interference issue. The hatches meet the Interface Control Document (ICD) requirements and the hatch interface meets the As-built vs. As-designed drawings. The team concluded that the ICD has a problem that may affect every hatch in the ISS program.

SSE completed all updates to the remaining open Node 2 hazard reports, obtained all required signatures and submitted them for review to SRP with all safety verifications closed except those verifications that use the Launch Commit Criteria document due to be released at Launch – 7 months (L-7) and L-5. The SRP chairman has signed all Node 2 hazard reports at a Phase III level. SSE is updating information on non-destructive evaluation (NDE) on the Node 2 welds and several other hazard reports that contain Operation Control Agreement Document (OCAD) verifications. SSE continues to review documentation and close additional Node 2 hazard report verifications contained in the Safety Verification Tracking Log.

SSE supported the SRP special topics to discuss the Node 3 Quick Disconnect (QD) resolution plan, the SRP accepted the rationale for the Node 3 QD's; all Alenia procured QD's will be to the new qualification and acceptance testing that verifies the secondary seal, the QD's integrated into the common use hardware Government Furnished Equipment, will be use-as-is with rationale submitted in the Non-Compliance Report (NCR) that supports it's use. NCR on the venting QD's will be submitted prior to November in order for the ISS International Partners (IP's) to have time to review the NCR.

SSE completed updates on three Node 3 phase II hazard reports. SSE supported one (1) SRP special topics telecon pertaining to Node 3 Quick Disconnect (QD) resolution plan, in which the SRP accepted all rationale for the Node 3 QD's. One assigned action was to accelerate the Hazard Report updates and/or generation of applicable Safety NCRs to support a use-as-is disposition for the AR Rack CO2 and MCA vacuum vent QDs. The SRP accepted our rationale but wants to air the Hazard Report/NCR with the International Partners.

SSE reviewed information to evaluate if hydrogen embitterment is a hazard to Node 3. The Hazard Reports are being updated for upcoming Delta Phase II Safety Data Package Review in November of 2004. SSE is updating Node 3 Hazard Reports for the upcoming Delta Phase II Safety Review. These reports have been updated with all available information that was provided from NASA, additional updates are being generated from Alenia and are scheduled to be delivered. SSE created and continues to update a Safety Verification Tracking Log (SVTL) for Node 3.

SSE participated in multiple telecons to status the NDE team plan. The resolution was that the ISS Structures and Mechanisms (S&M) team initiated an effort to validate the Alenia work that formed the basis of not performing post proof test NDE for Node 2 and MPLM modules. The team reviewed and validated the Leak-Before-Burst (LBB) approach and reviewed the safe life approach as an alternate to the LBB approach, with the objective to complete the validation assessments in support of Node 2 and

MPLM schedules. The team also implemented a Weld film coupon test to establish if the coatings that are used to cover the welds will prevent leakage of air from weld cracks (testing to be completed 9/28). At this time the Node 3 is undergoing NDE evaluations at the Alenia manufacturing facility in Italy.

SSE participated in the weekly Nodes/Alenia teleconference. Comments on the NASA/European Space Agency (ESA) Nodes 2/3 Project Joint Implementation Plan was reviewed real-time and additional comments provided. SSE suggested that the a safety review paragraph be added to section 4.5, it was noted that in section 4.4, Safety an Mission Assurance referenced the document "Nodes Bilateral Safety and Product Assurance Requirements", SSPXXXXX (number not yet assigned, going through configuration management at this time) and the information is contained in the document. The SSE completed the review of the bilateral Safety and Product Assurance document; no impacts to S&MA were noted.

SSE is developing a set of Oxygen Generator System (OGS), Oxygen Generation Assembly (OGA) plus Power Supply Module (PSM) level hazard reports which are separate from the Node 3 level reports and deal only with ELCSS OGS hardware. SSE is reviewing the OGA System Safety Analysis report from Hamilton Sundstrand (Revision D) and incorporating changes into the OGS level hazard reports. SSE has reviewed 25 new verifications (OGA). These verifications were discussed in detail during the OGA Functional Configuration Audit. Currently, there are 30 additional verifications ready for review. Eight (8) of the ten (10) verifications reviewed this period were approved. Two (2) verifications were disapproved because an incorrect procedure was attached to the verification. An OGA Verification Log is being maintained to track verification approvals/disapprovals.

Safety Engineering (SSE) has reviewed multiple OGS and seven (7) PSM test procedures for the testing at MSFC. Comments to the procedures were minor and the test procedures were approved by SSE. No significant safety impacts have been identified.

SSE supported the Urine Processor Assembly (UPA) and Water Processor Assembly (WPA) team meetings. SSE also reviewed and commented to six (6) test procedures for the UPA. SSE made additional updates to the Water Recovery System (WRS) hazard analysis based on updates to the WPA hazard analysis. SSE also made requested updates to the Regenerative Environmental Control and Life Support Subsystem (ECLSS) diagram in the WRS hazard reports. SSE also reviewed and commented to seven (7) sets of test procedures for the WRA.

SSE participated in the three-day FCA of the OGS Oxygen Generator Assembly at Hamilton Sundstrand which began on 09/19/04. Twelve verifications were reviewed. One of these was not approved due to inconsistencies between the verification report and the hazard report. Overall, the audit was a success.

SSE supported the normal Programmable Thermostat System (PTS) and Multipurpose Logistics Module (MPLM) team meetings. SSE reviewed the closure for four (4) ALERTs and provided comments to two (2) Space Station Change Notices (SSCN's) and one (1) document. SSE updated, obtained project approval, and submitted MPLM/Orbiter Hazard Report MOI-7 which was subsequently signed by the Payload Safety Review Panel (PSRP). SSE submitted the MPLM Programmable Thermostat System (PTS) ground safety assessment which was approved by the Ground Safety Review Panel (GSRP). SSE also supported the Support Equipment Control Board review of the MPLM PTS Ground Support Equipment.

SSE supported the MPLM and Node 2 Weld Inspection Meeting in addition to the normal team meetings. During the meeting fracture control representatives from MSFC Materials, MPLM, Node 2, the National Engineering and Safety Center (NESC), and the International Space Station (ISS) Program Office

discussed the schedule options for inspecting the welds on the MPLM. The MPLM Project cannot proceed until the NASA Fracture Control community agrees on the correct technical approach. The currently favored option is the inspection of all the critical welds on either MPLM Flight Module (FM) 1 or 3. Programmable Thermostat System (PTS) flight set number three completed all of its required testing and was shipped to KSC for installation onto MPLM FM3. This completes all of the PTS hardware assembly and testing at MSFC.

SSE supported the normal Biological Research Project (BRP) meetings and the Station Problem Resolution Team Meeting this week. SSE also supported the final DD250 of Habitat Holding Rack (HHR)-1. SSE supported development of a Safety Data Package (SDP) with the Specimen Survival Mode updates and meeting with the Payload Safety Review Panel (PSRP) for the HHR-1 and -2. The PSRP agreed with the Project's approach and the proposed changes to the SDP. Once the BRP Project submits the updated SDP to the PSRP, it will formally close the last remaining action for BRP. HHR-1 was shipped to KSC and successfully completed its post shipment checkout. S&MA was notified the week of 09/20/04 that the Safety Verification Tracking Log (SVTL) for the HHR rack has been closed out. A copy of the SVTL has been forwarded to the PSRP.

SSE also supported the HHR-2 status meeting to meet with Boeing – Huntsville to evaluate the amount of work left on HHR-2 prior to the Acceptance Review and decided to go ahead with the review plans as scheduled. HHR-2 acceptance testing and PaRIS installation are now complete. FD26 had one mishap with a relay module for the Solid State Power Control Module (SSPCM) for the Materials Science Research Rack (MSRR). The root cause was an over-baked card due to operator error. The vendor, Wildwood, has agreed to replace the card at no cost to the project.

SSE continues to work with the Project Managers for Materials Science Research Rack-1 (MSRR-1), MSRR-1 Integration & Operations, and Gravitational Effects of Distortion on Sintering (GEDS) experiment, plus support personnel to discuss the Phase III flight & ground safety review process. Comments on the existing package have been solicited. The SSE received an approval letter from Payload Safety Review Panel (PSRP) concurring with the submitted plan of action for presenting the Phase III flight reviews. Next it will be forwarded to European Space Agency (ESA) for concurrence. The letter will provide to ESA as a guide for preparing the safety packages they are responsible for. SSE has also coordinated a Technical Interchange Meeting (TIM) with the PSRP for the review of the design approach for the Thermal and Environmental Control Shelf (TECS) over-pressure protection plan. This TIM, which will be conducted via Web-Ex, is scheduled for 0900 on 10/28/04.

SSE supporting Microgravity Science Glovebox (MSG) Integration activities investigated and initiated work for obtaining a durable certification for the ORU's and to implement changes to MSFC-RQMT-2888. SSE reviewed the SMOKE (not an acronym) Phase 0/I Flight Safety Data Package (SDP) and sent comments back to the author. SSE also continues to develop the SHERE SDP. Both experiments plan on using the Microgravity Science Glovebox (MSG) facility in 2006.

SSE received and incorporated comments on the draft Quench Module Insert (QMI) Phase III Flight Safety Data Package from team and QD30 management reviews. SSE confirmed with the project controls and verifications that will be performed and addressed and incorporated all comments. SSE submitted the Phase III Flight Safety Data Package to the QMI Project Manager on 09/14/04, for inclusion in the closeout documentation for QMI. SSE supported meetings to review the content of the QMI Shelving Plan. SSE provided S&MA Lead support in the process of shipping QMI ground and flight parts to TBE as part of the SDOS contract

SSE is continuing to support g-LIMIT efforts to determine the source of anomalies experienced in the performance testing of the Flight Unit. S&MA will continue to support the resumption of Verification & Validation (V&V) testing on the flight software and all subsequent software testing on both the Flight Unit (FU) & Flight Unit Spare (FUS). As a result of the anomalies experienced, the status for g-LIMIT continues to be "Red".

SSE participated with ESA in a four (4) day Technical Interchange Meeting (TIM) pertaining to the Gravitational Effects on Distortion in Sintering (GEDS) experiment. The major issue arising was performance of the thermocouple which resulted in ESA engineering action items. Other topics included design processes, analysis techniques, and safety requirements.

SSE participated in an Operations and Safety review of the Material Science Lab (MSL). The review and comments were presented to the hardware developer (EADS).

SSE has completed the first functional version of a Software Safety web site and has submitted it to management for review and comments to enhance the efficiency of all team members allow us to minimize cost to the customer.

4.2 Reliability

4.2.1 Reliability & Maintainability Engineering (R&ME)

Reliability and Maintainability (R&ME) is supporting the ongoing JIMO Program by studying available documents to determine areas of interest or concern in order to help direct search for relevant lessons learned. Such information is captured and published in the JIMO Lessons Learned New letter each month. R&ME has completed the System Fault Tree (FTA) for the JIMO project and provided it to Jet Propulsion Laboratory (JPL). The AACS (Attitude Articulation Control System) TELCOM (Telecommunications) and C& DH (Control and Data Handling) TB2 (Technical Baseline 2) fault trees are complete and also incorporated into the JIMO System Level Fault Tree. Since this time the R&ME Team has received comments to the JIMO TBR 2 System Level Fault Tree that was delivered to JPL. These comments will be incorporated into the subsequent TBR 2 Fault Tree. The next phase of the JIMO TB System (2.5) Level Fault Tree continues to be developed for submittal to JPL. During this reporting period R&M Fault Tree analysts along with the GRC analysts traveled to Jet Propulsion Laboratory for a 2-day Fault Tree Analysis Workshop during which JPL comments to the FT's were discussed. The JPL JIMO team presented their FT review process to be followed by the next submittal. The JIMO spacecraft subsystem teams also presented an overview of their designs that will be helpful in performing future Fault Tree Analyses. The roles and responsibilities between the MSFC, GRC analysts and JPL lead analyst were discussed and confirmed during this workshop. R&ME continues providing support to the TR107 LOX/RP1 Engine by reviewing coking studies in order to help provide input on coking impacts to reliability. R&ME also attended the Mid Term review and is in the process of reviewing the FMEA. R&ME supported the requirements development for Human Rated Launch Vehicle (HRLV) by providing inputs and comments to the Reliability and Maintainability sections of the proposed HRLV requirements. During 4th Quarter of Fiscal Year 2004 the Systems Analysis Project team for Next Generation Launch Technology (NGLT) was selected as one of the 2004 NASA 'Turning Goals Into Reality (TGIR)' award winners. Also prepared and submitted during this time were seven NGLT lessons learned in the areas of: S & MA, Life Cycle Analysis and Organization Discipline Team. R&ME was represented this quarter as a member of the Exploration Task Team [ETT] Integrated Process Team [IPT] Formulation Team. The IPT Formulation Team completed its "Preliminary IPT Formulation Recommendations for Project Constellation" and presented these results to the appropriate NASA Center points of contact. Project Constellation was also supported through R&ME efforts in order to develop a set of documents for defining program requirements and deliverables for the Reliability, Maintainability and Supportability functions. Document outline and source requirements (from NASA NPR's) have also been provided for

FMEA and FTA methodologies documents. Work is now underway on writing the Project Constellation FMEA Methodology standard.

In support of the Exploration Systems Missions Directorate [EMSD] Integrated Discipline Team [IDT] Formulation Team a bottoms up S & MA IDT estimate has been prepared by R&ME for FY05 Operations and CEV support. This estimate was forwarded to the S & MA IDT Team Lead and his deputy with the expectations that this estimate will be forwarded on to LaRC for review and comments. R&ME has communicated its latest revisions of subsystems FMEA/CILs to IPTs for review and comment along with completing its review of the X-37 Orbital Flight System/Long Duration Orbital Vehicle/Automated Landing Technology Vehicle (OFS/LDOV/ALTV) program documentation. This was done in order to provide feedback to changes necessary to ensure that traceability would flow to proper allocations and requirements. Boeing's submittal for ALTV system and component reliability predictions have also been reviewed as well as submitting system review comments from MSFC's design teams to Boeing's design team counterpart. All work relative to ALTV reliability is complete to date with all comment submittals delivered to Boeing's IPT for discussion/inclusion in the design. R&ME began its development of Return to Flight's preliminary draft copy of the Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) for the Excitation Power Box (EPB). This draft is to be used in Developmental Flight Instrumentation (DFI) for the Shuttle external tank (ET) program. The draft version was submitted to the appropriate design group for review with continued information gathering for the next iteration. A review of FMEA/CIL design group leads, in order to populate the CIL portion of the document, has also been arranged.

Reliability and Maintainability (R&ME) continues to provide dedicated support to Return-To-Flight activities as well as day-to-day activities by thoroughly reviewing all current SRB, RSRM, SSME and ET Critical Item Lists (CIL's) and potential CIL's for retention rationale pertaining to the Space Vehicle Assurance Group/QD20. In addition to reviewing numerous CIL's, R&ME also participated in several Preliminary Requirements Reviews (PRR's), Preliminary Design Reviews (PDR's), Critical Design Reviews (CDR's), Design Certification Reviews (DCR's) and STS-114 Project Milestone Element Acceptance Reviews (EARs) for new hardware designs, redesigns and technical issues such as; SRB Bolt catcher, NASA Standard Igniter Pressure Cartridge (NSIPC), Thiokol's Booster Separation Motor (BSM), BSM Igniter, Enhanced Launch Vehicle Imagery System (ELVIS), RSRM Inactive Stiffener Stub Thermal Protection System (TPS), ET Imagery System, ET LO2 Feed-line Bellows, ET Bipod, ET Flange, Integrated Vehicle Instrumentation System (IVIS) and the Integrated Electronics Assembly (IEA) Integrated Product Team (IPT). R&ME has also remained an active member of the weekly Space Shuttle Program (SSP) Reliability and Maintainability Panel held jointly with Johnson Space Center (JSC) to ensure that R&M programmatic and technical requirements are implemented within the program. R&ME has remained active in its training and knowledge enhancement of the Space Shuttle Program (SSP) through participation in the SSP Data-Mining & Trending Workshop held at NASA's Marshall Institute in Huntsville, AL. The purpose of the NASA-JSC sponsored workshop was to understand the what's, where's, when's, how's and who's that are available for the data-mining and trending process for the SSP and also to develop a consistent data-mining and trending process for all SSP elements based on team synergy of NASA, Contractor team members and best practices from industry. The desired outcome from this workshop is to develop a roadmap for an effective, efficient, responsive, meaningful and easy to use data-mining and trending processes for key LRU and critical processes related to SSP hardware. R&ME conducted a Process FMEA (P-FMEA) on the Shuttle RCC (part of the Thermal Protection System (TPS)) composite repair material (CRM) which is designed to allow on orbit repair of damaged RCC panels.

4.2.2 Problem Assessment Center Operations

HEI's PAC personnel processed and coordinated disposition of problem reports; coordinated the MSFC Problem Assessment System; coordinated restoration of normal problem processing following Columbia-

fostered redesign activities; participated in an STS-114 countdown simulation; coordinated MSFC review, impact, approval, and implementation planning of the NSTS 08126 Revision J "Shuttle PRACA Requirements", and operated the Corrective Action System (CAS). The PAC received and entered 38 new problem report (PR) into MSFC's Problem Reporting and Corrective Action (PRACA) System, coordinated MSFC interim closure of 21 PRs, received 21 prime contractor closure recommendations, supported MSFC full closure of 22 PRs, coordinated non-problem closure of 12 problems, and performed 228 individual PR database updates and reviews. We conducted 7 SSME problem review boards (PRBs) resulting in dispositioning 42 of 48 problem reports presented, including maintained storage of supporting Unsatisfactory Condition Report (UCR) data on a common-access server. The PAC generated or updated trends for MSFC Shuttle problems submitted as newly opened and for closure. We also generated and distributed monthly problem bubble trend risk charts and briefed the charts at the monthly SRB Problem Assessment System (PAS) review. We reviewed 6 requests for access to the MSFC PRACA database and granted all of them. We also taught a class on Shuttle PRACA requirements, data systems, and processing techniques to 12 HEI and Shuttle Project personnel.

In support of return-to-flight, we continued to coordinate MSFC's review, impact, and ultimate approval of proposed change S062082D to NSTS 08126, Space Shuttle Problem Reporting and Corrective Action (PRACA) System Requirements. This included assisting preparation, presentation, and/or discussion support of evaluation charts at PRACA Change Tiger Team meetings, at the MSFC Shuttle project reviews, at the Propulsion Management Council (PMC), and at the Shuttle Program Requirement Configuration Board (PRCB) and circulating results of the meetings. We also circulated within the MSFC community, clarified for the MSFC Projects and prime contractors, reviewed contractor interpretations and proposed implementations, and assisted in briefing Shuttle Level 2 on the PRCB-directed follow-on actions to the Revision J PRACA requirements approval. We also coordinated MSFC review and discussion with Shuttle Level 2 on proposed revisions to the definition of Process Escapes and the quarterly review meeting method directive. Furthermore, we surveyed RSRM's post-flight assurance report (PFAR) process and reviewed and red-lined proposed changes to the RSRM problem reporting implementation plan based on Revision J of NSTS 08126.

In support of the Constellation Program, we reviewed NASA requirements for related problem-reporting requirements, included those requirements in a Constellation master requirements list, generated a PRACA methodology document outline based on those requirements, and generated a proposed PRACA methodology document for Constellation Program review and implementation.

The PAC provided various problem data in support of NASA and MSFC analyses. Regular activities included providing daily KSC PRACA shuttle problem summaries, daily MSFC PRACA open-against-next-mission summaries, daily KSC Resident Office reports, monthly newly opened/closed problem summaries (including a newly added engineering assessment of the data), weekly SRB PRACA and ALERT activities and status reports, and quarterly Open Problems List (OPL). Special activities included: (1) researching and providing a tabulation of all Shuttle In-Flight Anomalies by project and mission for NESG; (2) providing problem histories on specific SRB part numbers for the SRB Project; (3) providing SSME KSC and MSFC PRACA problems on failed inspections of Incoloy/Alloy 903 materials/overlays, missed penetrant inspections, main injector head shield retainers and aft manifold debonding; (4) MSFC PRACA SSME problem data related to foreign object/debris (FOD) or contamination since STS-107, related to main injector disassembly, and related to plumbing and interconnect system welds.

In problem trending, we generated regular problem entry and disposition problem histories; issued monthly bubble trend charts with interpretations of data; reviewed, evaluated, and commented to a proposed recurring problem trend based metric proposed by the Shuttle R&M Panel; generated SRB and SSME recurring problem trends for the last 18-month and the last 48 months of submitted data; uploaded

follow-up information (presentations, team reports, and attendees/contacts information lists) to the Trend PBMA site; and participated in 2 Shuttle S&MA Panels and 1 Shuttle PRCB meeting on data mining and problem trending .

In implementation and operation of the MSFC Corrective Action System (CAS), we received 36 potential CAS reports, screened 35 draft Recurrence Control Action Requests, elevated 4 to new Recurrence Control Action Requests (RCARs), coordinated 9 point of contact (POC) responses, and facilitated 7 Corrective Action Boards (CABs) resulting in closure of 5 RCARs. We also provided and discussed CAS metrics and open RCAR status reports at Marshall Management System (MMS) Implementation Team meetings, and issued monthly RCAR status and delinquent response reports. We provided data to the monthly S&MA Management Status Reviews, and briefed to acting Associate Center Director and the newly-appointed Associate Center Director on the Corrective Action System and her role in processing and evaluating the metrics. We updated 5 MSFC directives and 2 QD organizational instructions per a NASA HQ action regarding separating of requirements from supporting/suggested data and submitted them to Centerwide or QD Document Control Board (DCB) review, respectively.

4.2.3 ALERT Program

HEI's ALERT support included both regular and special activities as we coordinated MSFC ALERT processing and participated in the NASA and general Government-Industry Data Exchange Program (GIDEP) activities. HEI received and distributed 33 ALERT announcements for MSFC review and obtained 952 responses from MSFC project, contractor, and laboratory contacts. We also provided notification, assistance, and support contributing to maintenance of the delinquent ALERT response count below 200 for the entire period. HEI ALERT support personnel 1) reviewed and approved 7 new MSFC ALERT database accounts via the TPS security; 2) generated monthly Open, Delinquent ALERT response tabulations and provided them to S&MA and/or Directorate single points-of-contact responsible for open ALERT reduction; (3) reviewed, formatted, and issued MSFC NASA Advisory NA-MSFC-2004-01 on ITT/Cannon out-of-shape electrical connector pins; (4) assisted ALERT processing and maintenance of actionee points of contacts for the MSFC projects and directorates; and (5) led activities of the Industry Advisory Group (IAG) of GIDEP as the IAG Chair and monthly Executive Council teleconference, the summer Business Session in Toronto, Canada, and through obtaining evaluation from the IAG of various changes to GIDEP procedures

4.3 Quality

Space Transportation

Space Shuttle Main Engine (SSME) Quality Engineering (QE) supported an audit of Pratt & Whitney (P&W) sub-tier supplier Peening Technologies (PT) that peens SSME parts. The audit team was tasked to investigate allegations of fraudulent activities at PT made by a former employee. No significant findings to support the allegations of fraud were uncovered.

SSME QE participated in the Delta Design Review of Pratt & Whitney's (P&W) High Pressure Fuel Turbo Pump Liquid Air Insulation (HPFTP LAI) redesign. The redesign effort was initiated as a result of a failure of the HPFTP Speed Signal on Channel B at engine start. The resulting design change Engineering Change Proposal (ECP) is currently under review, and QE has informally submitted a list of comments that will result in modification to the ECP and subsequent Verification Complete Report.

Reusable Solid Rocket Motor (RSRM) QE participated in the STS-114 (RSRM-90) Element Acceptance Review and Delta Element Acceptance Review conducted at MSFC. QE continues daily activities of reviewing engineering change proposals, process change proposals, and Material Review Board items for quality and certification impact. QE participated in integrated reviews of numerous Change Requests impacting Space Shuttle Program quality. QE has continued to act as the S&MA main point of contact for the RSRM Propellant Structural Analysis issues and pending waiver and the Propellant Slow Cast

UUEC investigation. RSRM QE continued to act as the S&MA point of contact for the propellant, liner, and insulation work centers and to lead weekly reviews of Thiokol's corrective actions.

Reinforced Carbon Carbon On-Orbit Crack Repair (ROCR) QE has supported the down-select process of the primary and secondary materials selected for the ROCR Project. Developmental testing will continue for the primary down-selected material and raw material vendor qualification will begin later this month. QE is updating the draft S&MA plan in preparation for the upcoming Preliminary Design Review to be held at MSFC.

Solid Rocket Booster (SRB) Quality Engineering provided support for the ET/SRB Bolt Catcher Qualification program. QE participation in a process audit on the Bolt Catcher at General Products Inc., provided technical review of Bolt Catcher manufacturing and test procedures for adequacy and accuracy.

QE supported the Booster Separation Motor (BSM) Cracked Throat debris investigation team effort. The failure investigation team is concerned with the graphite debris emanating from the Forward BSM's, due to cracks in the nozzle throat. QE continued supporting the BSM graphite nozzle bond-line tiger team. Reviewed and evaluated SRB Return-to-Flight test procedures. QE supported the BSM Redesigned Igniter Qualification program, BSM Plume Characterization program, and BSM Graphite Nozzle FEM Adhesive response validation test program. QE participated in the weekly ADAPTS meetings.

SRB Pyrotechnic QE represented QD20 Pyrotechnics S&MA at the NSI-PC pre-shipment incremental Phase III Review conducted at Pacific Scientific Energetic Materials Co., Chandler, AZ. 40 Lot ABD NSI-PCs were incrementally accepted for shipment to KSC to meet the SRB assembly schedule. Lot ABD is the first lot of NSI-PCs to incorporate the NSI retention feature designed to eliminate NSI ejection.

SRB Pyrotechnic QE represented QD20 Pyrotechnics S&MA during the SRB Frangible Nut Phase III Review held at the Assembly and Refurbishment Building, KSC, Florida. Eleven Frangible Nuts modified to a new rounded hex corner configuration were presented for inspection. Associated data was evaluated.

SRB Pyrotechnic QE represented QD20 Pyrotechnics S&MA during the inspection of Confined Detonating Fuse Initiators and CDF Assemblies at the Ordnance Storage Facility, KSC, FL. The pyrotechnic components were removed to allow the stripping and re-application of Thermal Protection System (TPS) materials on multiple flight sets of SRB Forward and Aft Assemblies because the extended launch delay caused the material to exceed the age experience base. The team conducted a thorough physical inspection of the hardware for any defects caused by handling during the removal process.

SRB Pyrotechnic QE was instrumental in preventing a test article inspection problem that would have adversely impacted the SRB Forward and Aft Separation Bolt structural factor of safety qualification tests conducted at MSFC facilities. While reviewing test documentation, QE realized that QA inspection of modified test article detail parts required for the test were not planned. QE immediately notified QD20 Pyrotechnics S&MA and the SRB Project Office and learned that the separation bolt assembly operations were planned for the following day. Had QE not identified and raised the concern to the proper organizations, the test units would have been assembled (an operation that includes the epoxy bonding of parts). QA inspections necessary to verify modified detail part compliance to the dimensional requirements specified in the test plans (a feature crucial to the factor of safety qualification test) would not have been performed, potentially rendering limited hardware assets unusable for the qualification test program. Test article assembly operations were postponed until the required QA inspections could be coordinated. The QA inspections were subsequently performed and several dimensional discrepancies were found and documented.

External Tank (ET) QE continues to lead the S&MA activities associated with the design, development, test and documentation for implementation of the ET Excitation Power Box (EPB). ET QE participated in a Return to Flight (RTF) Intertank / LH2 Tank Flange Technical Interchange Meeting and a RTF Intertank / LH2 Tank Flange Critical Design Review. In addition, ET QE continued day-to-day activities which included participating in the monthly Quality Escape telecoms, weekly RTF meetings with Lockheed Martin (LM), and weekly Hardware Certification Sheet / Certificate of Qualification reviews with MSFC and LM.

Quality Engineering provided technical team support to the External Tank Return to Flight efforts which included the Preliminary Design Review and Critical Design Review of the Bi-Pod redesign and LH2 Inter-tank Flange Redesign, both in-house and on site at Lockheed Martin.

Quality Engineering provided overall coverage for all operations conducted on the Demonstration of Autonomous Rendezvous Technology (DART)/Advanced Video Guidance Sensor (AVGS) final checkout and testing at the MSFC test facilities. With the successful completion of this test AVGS S/N 004 was deemed flight worthy and ready to be installed on the DART Spacecraft.

Quality Engineering supported the NASA Workmanship Technical Committee by participating in several Telecons and meetings on the proposed splices section for NASA-STD-8739.4. QE participated in several Telecons with Joint Group on Pollution Prevention's (JG-PP) Lead Free Solder Project for QD20.

Software Quality Assurance (SQA)

In preparation for the Material Science Research Rack (MSRR) Formal Verification and Validation Software (SW) Testing Test Readiness Review (TRR), Software Assurance (SA) completed an audit of traceability between System level requirements, flight software requirements, and SW test procedures. A total of 6 findings and 1 observation were reported. SA also witnessed and stamped 33 of 125 SW test procedures for submittal to the project for verification items closure. SA conducted three Orbital Express (OE) Audits. These were Software Development Plan (SDP), Software Configuration Management Plan (SCMP) and Software Requirements Specification (SRS) Audits. SA participated in OE Code Reviews for Segment Mode and Maintenance Mode. SA participated in peer review for OE Software Test Plan (STP), X-37 Technical Review Board (TRB) Meetings, and Software Configuration Control Board (SCCB) Meetings. SA participated in weekly Orbital Express Status Meetings, OE/DART Risk Mitigation Meetings and supported the OE Critical Design Review (CDR). SA completed CMMI Refresher Training at Marshall Institute, completed Test Area Training with Transportation Directorate (TD), and developed draft version of the Constellation Software Assurance Plan.

ISO/AS9100

QE has continued to play a key role in ensuring the maintenance of ISO 9001 and AS9100 at MSFC during this time period. Efforts have dealt with continuing implementation of ISO 9001 and AS9100, maintenance of documentation (including the revision of three documents), and planning and support for the next NQA registrar surveillance audit. QE also has continued follow-up of corrective actions from the last NQA audit. QE provided general ISO and AS9100 support, including reviews of both MSFC and NASA Agency documentation and consulting support on internal audits, records, and other aspects of ISO 9001 and AS9100, to various MSFC Organizations. QE has been involved with the NASA Headquarters rules review action, including participation in the focus team that set the ground rules for implementation and tracking by MSFC, assisting with the S&MA inventory, assisting multiple organizations with review and revision of directives, providing input on all directives to the S&MA Directives Control Board member, and ensuring ISO 9001 and AS9100 requirements are retained. QE also participated in a NASA Agency Quarterly Quality System Status Review meeting at NASA Headquarters.

Payloads

Quality Engineering (QE) participated in a site visit to Plasma Processes Inc. (PPI) the manufacturer of the GED's cartridge.

QE reviewed Delta L Phase II SDP and Phase III SDP (safety data package).

QE attended a Quality System Review at Carbon-Carbon Advanced Technologies (C-CAT) for the X-37 project.

QE reviewed and provided comments to the Acceptance Data Package (ADP) and Qualification Test Report (QTR) for the First Material Science Research Rack (MSRR-1) Qualification and Flight models Solid State Power Control Module (SSPCM).

QE provided support for Ames Research Center personnel in the acceptance for the 2nd Flight Rack for the Habitat Holding Rack (HHR) project.

QE assisted in preparing and reviewing the ADP for the 3rd Flight Set and Spares for the Multipurpose Logistics Module (MPLM).

QE assisted in the writing of the Level II Quality Assurance Plan for the Constellation Program.

QE performed drawing reviews, test procedure reviews, test readiness reviews, and procurement reviews, inspection requirements, shipping requirements, and supported team meetings for Environmental Control Life Support System (ECLSS). QE reviewed and provided comments for safety and specification verification closures for ECLSS. QE provided quality expertise to Material Review Boards for ECLSS.

QE conducted a Functional Configuration Audit (FCA) and conducted a delta Physical Configuration Audit (PCA) of the ECLSS Oxygen Generator Assembly (OGA) at Hamilton Sundstrand in Windsor Locks, CT. QE also, conducted a second FCA.

QE reviewed flight flex hose and flight quick disconnect ADP's for the Material Science Research Rack (MSRR).

The Phase III Ground Safety Data Packages (GSDP) was reviewed by QE and comments provided to the Delta-L project team. QE participated in Configuration Change Board approvals for the Phase III GSDP and other Delta-L documents.

QE provided review comments for all GEDS Engineering Change Proposals and participated in Configuration Change Board approvals.

QE conducted a Quality Review of data submitted by the Smithsonian Astrophysical Observatory to support a Pre-Ship Review (PSR) of the X-Ray Telescope (XRT) to Narita, Japan. Quality Engineering had two issues with the PSR package; the XRT Nonconformance section was incomplete and the Temporary Installed Items section was incomplete. Quality Engineering also attended the XRT PSR held at the National Space Sciences Technology Center (NSSTC) and reported its issues.

Inspection and Test

Quality Engineer (QE) for the Test Area was responsible for the review, revision, release of procedures, and testing of the Northrop Grumman composite tank. QE performed review, release, closure of procedures, and testing of the cold flow hydrogen rig to support LAI investigation. QE reviewed and

released work-authorizing documents for the Northrop Grumman composite tank, cold flow hydrogen rig to support LAI investigation, and the build up for the Bipod Hydrogen Heater Control system test.

Quality Assurance (QA) personnel monitored the re-certification test at the Hot Gas Facility of North Carolina Foam Industry (NCFI) 24-124 and NCFI 24-57. This test on external tank foam is a Qualification/Certification test. The objective of the test are to obtain an quantitative assessment of the recession data of the NCFI 24-124 formulated with the tin catalyst change for comparison with historical data and recession data from similar testing of NCFI 24-124 with tin catalyst change at Arnold Engineering Development Center (AEDC) by measuring the remaining char thickness, pyrolysis thickness, heat effect area thickness and virgin material thickness. This test is being performed on test plan ETPP-MS-04-055.

QA personnel monitored the Aft Manifold Ablative Certification Testing at Hot Gas Facility. The primary objective of these test's are to verify the bond joint strength between the ablative material and the aft manifold closure simulating flight conditions in Ascent, Orbital and Re-entry for current and modified systems. Compare the bond joint strength between the current ablative with RTV adhesive and the modified ablative process without adhesive. Determine the safety margin of the new design by achieving bond line temperature more than 800 degrees F and higher air load (Maximum air load at which the bond joint fails).

QA personnel monitored Inactive Stiffener Stub Cork at the Hot Gas Testing Facility. The test was performed to address flight safety concerns by demonstrating that proposed Thermal Protection System (TPS) close-out will perform adequately under flight ascent aero thermal heating and loading conditions.

QA personnel monitored testing of the Staged Combustion Injector Technology (SCIT) motor testing. The objective is to provide a means for MSFC to validate computational fluid dynamics injector models for conditions at which little data exist and for engine cycles that are of critical importance to emerging engine concepts, namely pre-burners in the Fuel Rich Staged Combustion (FRSC) cycle

QA personnel performed the final visual weld inspections and non-destructive evaluations for the 24-inch Solid Fueled motor test position at the SPTA test facility following completion of the fabrication of all of the thrust structure elements.

QA personnel monitored the final 15 tests of the Staged Combustion Injector Technology (SCIT) test series at Test Stand 115. The objective of the series was to measure Infrared Emissions across the combustion chamber using two Scanning Spectrometers.

QA personnel monitored RTF testing of the High Pressure Fuel Turbopump Liquid Air Insulation (LAI) at the Hydrogen Cold Flow (HCF) facility. The test article is a Pratt and Whitney SSME Fuel Turbopump with proposed flight configuration insulation installed on the exterior surfaces.

QA personnel verified the assembly and hydrostatic pressure test of the heat exchanger assembly for the Cryogenic Injector Spray Characterization test series at Test Cell 110.

QA personnel assisted in a dry-run walk through of the baseline LOX Storage and Transfer System Standard Operating Procedure (SOP) for Test Stand 500 to verify new procedure prior to its release.

QA personnel witnessed functional testing of the Urine Processor Assembly (UPA), Power Module Box to confirm that the Power Module Box was functioning properly.

QA personnel witnessed an abbreviated functional test of the Urine Processor Assembly (UPA) Data Module. The test was run to check the basic functional performance of the Data Module.

Quality Assurance (QA) personnel supported the Environmental Control Life Support Systems (ECLSS) Project with inspection and data review activities. Inspected / reviewed work orders and data for the 96M11850-1 PCPA Shelf Assembly; 96M21934-3, -5, -7, and -9 Speed Sensors; 96M12366-1 Distillation Assembly, and 96M12251-1 SPA. Presently inspecting / reviewing sub-tier work orders. Witnessed functional testing of 96M12250-1 Separation Plumbing Assembly, (SPA), and 96M12280-1 Waste Water Storage Tank Assembly (WSTA); the vibration testing of the 96M12280-1 WSTA, test anomalies and non-conformances were noted on Test Discrepancy Sheets (TDR) and Discrepancy Records (DR). Witnessed the metal seal leakage, proof and pressure testing of the 96M12560; Hamilton - Sundstrand male Quick Disconnects (QD) per Test Preparation Sheets.

QA personnel supported the ET / SRB Return to Flight testing and inspection activities. Witnessed the SRB / NSI Retention Device and Pressure Cartridge, Forward and Aft Separation Bolts Structural Factor of Safety Qualification test at the Pyrotechnic Lab; the proof and pressure (burst) qualification testing of the Forward and Aft Bolt Retainer Assemblies at the High Pressure Testing Facility also the Vibration and acoustical qualification testing of P/N 10175-0020-101, ET / SRB Bolt Catchers, absorber material, and Bolt Catcher Machined Cork Test Panels. Dimensional inspections were performed and recorded on the ET / SRB Bolt Catchers.

4.4 Information Management (IM)

Information Management (IM) completed several major initiatives during the quarter. IM completed a Marshall Operational Readiness Review (MORR) with representatives of the Chief Information Official (CIO) and received approval, following completion of associated action items, to deploy the Audit Tracking Information System (ATIS). The application, which has been used for several months in beta mode, is deployed for use by MSFC internal team personnel to manage all aspects of the audit function from scheduling through audit closure. The MSFC Problem Reporting and Corrective Action (PRACA) system was revised to migrate the database and upgrade the application to operate on a different platform; the change will save S&MA approximately \$14K yearly. The revised S&MA website, which was designed to resemble the NASA home page, was deployed and all supporting mechanisms, such as instructions for administrative activities, were implemented. The site uses a template and libraries for standardization, and many administrative functions were automated through use of a database. Two system administrators received Patchlink training and the tool was installed on all S&MA-managed systems. Security plans for S&MA applications other than PRACA, Eport and Integrated Risk Management Application (IRMA) and a stand-alone machine managed by S&MA were revised and approved by the MSFC Computer Security Official.

IM completed the initial requirements of the System Builder module for the Statistical Tool for Assessing the Risk of Space-exploration (STARS), which will assess the risk and reliability of future Space Exploration missions. IM also developed the Shuttle Assurance Issues Database (SAID), which will be used to track technical issues, and deployed it for beta testing; the application will be revised to incorporate a security structure. Significant changes to S&MA's integrated login application, the Supervisor Safety Web Page (SSWP) and the Problem Assessment Center's web site management process were incorporated to improve the security posture and simplify management of accounts and data. A program was developed to update mishap data from NASA's Incident Reporting Information System (IRIS) and then to publish that information for MSFC users through Safety Search, Personnel Mishaps and Close Calls (PMCC), and Mishaps by Buildings. This methodology was devised by HEI and MSFC is the only center that has access to IRIS data for use at the center; the process is being investigated for use NASA-wide. SSWP was revised to display findings by fiscal year; to allow users to search and view actions by "suborganizations" per a customer request; and to allow association of organizations, which

will assist users in the upcoming center reorganization. The "association" function was suggested, designed and implemented by HEI prior to the center reorganization to minimize user problems accessing SSWP when their organization code assignments change. Significant modifications were also made to the Certification Tracking (Certrak), Inventory of Hazardous Operations (IHOPs), SHEtrak, Alerts Tracking System, Audited Vendor List/Limited Vendor List/Project-Specific Approved Supplier List, As-Built Configuration and Status System (ABCSS) and Peer Awards applications as well as the Contractor database. IM also provided the capability to insert risk information into a database and to provide for internal review of JIMO data prior to submission to the project office. Many of these projects, such as development of STARS and the JIMO functionality, were worked due to a pressing need by the project office, by utilizing part-time and Special Projects personnel to assist in on-going tasks.

IM participated in meetings with Code Q personnel and the development team of the Safety & Mission Assurance Requirements Tracking System (SMARTS) at NASA headquarters to determine a method of cooperating on future development efforts. IM continued participation in Continuous Risk Management (CRM) team activities, including design and incorporation of web-site requirements. IM updated two Organizational Instructions and developed a draft Marshall Work Instruction for *MSFC Input to NASA Lessons Learned Knowledge Network (LLKN)*. IM also supported LLKN team telecons and coordinated the incorporation of OSP Lessons Learned information into the LLKN.

4.5 Human Exploration and Development of Space (HEDS) Assurance

IA Analyst attended week long training on applied systems engineering at the Marshall Institute. The course, aimed at personnel not currently performing professional systems engineering, identified the elements of a systems engineering model and provided a description of each of the elements of the model. The role of systems engineering in the various phases of the project life cycle was discussed and analyzed. The course stressed the implementation of good communications, good requirements and understanding interfaces with space hardware engineering systems.

Independent Assessment (IA) participated in an investigation of allegations received by the SSME Project Office against Peening Technologies (PT), East Hartford, CT (IA Assessment MH-4006). These allegations cited shortcuts in processing and falsifying quality records on SSME turbopump parts. PT, as a sublevel vendor to Pratt Whitney, processes pump components through a surface hardening process called shot peening. IA along with HEI Quality and MSFC S&MA visited Pratt Whitney and PT, conducted interviews with personnel involved and reviewed all purchasing and quality documentation. The results of this assessment have been documented and an out-briefing presentation has been prepared.

Field activities of the Independent Assessment (IA) of the procurement Quality Control at Lockheed Martin (LM) Michoud (MH-4001) have been completed. A draft report has been submitted for MSFC IA management review.

The Independent Assessment Team (IAT) has completed the External Tank Bi-Pod Redesign assessment evaluating the critical design review (CDR) processes used, the technical adequacy of the redesign and its associated verification and validation activities. A report documenting these activities with observations and recommendations included has been written, edited, approved and released. The IAT is preparing a distribution list and an out briefing summarizing this report to offer to the ET project. The major challenge with the bipod redesign as with all the thermal protection system (TPS) areas continues to be the flight certification of the manually sprayed TPS closeouts. Completion of the outstanding items required from the CDR has become schedule critical since the ship date of ET-120 is less than 2 months away and the design certification review (DCR) is planned for early December 2004.

The Independent Assessment Team (IAT) has completed the investigation of the process and data used to formulate a decision for the External Tank (ET) protuberance airloads (PAL) ramp for the next two flight

ETs (ET-120 and ET-121). The Space Shuttle Program (SSP) agreed with the project recommendation to use the PAL ramps on these two flight assets in the "as-is" condition even though several organizations involved in this decision recommended that the PAL ramps be removed and reapplied with enhanced foam spray processes. IAT has completed the report of this assessment and it has been approved for distribution.

The Independent Assessment Team (IAT) participated in a Technical Interchange Meeting (TIM) at the MAF which was organized to formulate a strategy and plans for completing flight certification of the External Tank (ET) Thermal Protection System (TPS). The IAT prepared a report the events from this TIM including observations, recommendations and a recommended logic flow diagram approach with decision gates concluding at a complete certification of qualification (COQ) or the required waivers. This report has been approved for distribution

The IA Team visited LM External Tank (ET) suppliers Machine Craft (Huntsville), Summa Technology, Inc. (Huntsville), Ducommun AeroStructures (Gardena Ca.), and Ducommun AeroStructures (Orange, Ca.) to review their procurement processes, and flow down of ET Quality Assurance (QA) requirements to these companies. Supplier procurement documentation indicated most ET QA requirements were being flowed down to the suppliers. The assessment field activities were completed with a visit to the MAF to review LM procurement processes during the week of August 9, 2004.

The MSFC IA Team supported Assessment JKM-4004, "Return-to-Flight (RTF): Assessments of Products from SSP RTF Actions SSP-4 (Accepted Risk Hazards) & SSP-9 (Failure Mode & Effects Analyses/Critical Items Lists)." The Independent Assessment Plan (for this Joint Assessment) was completed, and the final revision released to the Team/IA Community. Copies of the preliminary KSC check/comment sheets, for RSRM Hazard Reports #BC-04; BC-07; BI-03; and, BN-04, were reviewed by the Team. Additional Accepted Risk Hazards and FMEA/CILs, previously reviewed by the respective projects, were reviewed to ensure compliance to established criteria. Independent Assessment (IA) also participated in the "SSME Return to Flight Accepted Risk Hazard Review" presented to the SSME Chief Engineer on August 18, 2004.

Independent Assessment (IA) participated in the HPFTP Liquid Air Insulation (LAI) Redesign Delta Design Review at MSFC held on August 10, 2004. This study and changes in design were a result of a Corrective Action Response to an STS-111 in flight anomaly, no HPFTP speed signal on Ch B at engine start. This problem was identified as liquid nitrogen formation on areas of the pump at cryogenic (LH2) temperatures that flowed onto the sensor. Of the 16 action items from the Design Review, 5 are closed and 11 are in work. Following successful testing of the LAI Insulation on the MSFC pump rig, the same LAI design was hot-fired at Stennis Space Center (SSC) on Test Stand A-1 for 350 seconds. This was the first of 2 tests to certify the insulation system for flight. There was no apparent liquid air on any of the turbopump components and no debonds on the RTV closeout material. This test will be repeated to certify the insulation design and installation.

MSFC IA participated in a Critical Design Review for the Intertank Flange of the External Tank at the MAF in New Orleans on Aug. 30th – Sept. 3rd. An Engineering Information Report was prepared.

An agreement was reached on an acceptable method of closing an open CDR RID written by IA against the BSM igniter re-designed retainer plate, which had demonstrated yielding test firings in the web between the 16 exits holes. This yielding was considered a possible source of metallic debris when the separation motors are fired. An inspection was conducted at Chemical Systems Division of the retainer plates in four igniters that were fired in an extreme worst case conditions (over pressure and over temperature), and if no material was seen to lost, the RID originator would accept that as rationale for closure.

IA participated in an External Tank (ET) project sponsored thermal protection system (TPS) technical interchange meeting (TIM) at MAF on 08/19/04. The objective of the TIM was to communicate to the Technical Community the progress made toward flight certification of the ET foam TPS to meet the critical debris limit requirements levied by the Space Shuttle Program (SSP) Level II on the ET project. In general, these limits are now defined to be a maximum of 0.04 pounds varying slightly with location and resulting transport energy. IA had significant input into this TIM. An Engineering Information Report documenting the observations and recommendations was prepared and submitted.

The MSFC Independent Assessment Team members submitted a report of the KSC GSE that Interfaces with SSP Flight Elements (KMJ-3011) assessment. The report provided considerable additional detail relative to each of the problems identified in the Out-brief. The IA Team will provide additional support as directed.

MSFC IA participated in the Reusable Solid Rocket Motor (RSRM) Element Acceptance Review (EAR) for the Flight Set 90 motors to be flown on STS-114. The RSRM Project had a complete EAR even though a delta review would have sufficed since the hardware in question was accepted previously. All Certification of Flight Readiness (CoFR) required topics to insure completeness were discussed. The board accepted the hardware to be ready to stack after completion of the open work as recommended by ATK Thiokol.

Investigations into the ETA Ring Corrosion problem are in work. Steps taken by NASA to alleviate this problem and avoid it in the future are being assessed by interviewing NASA and USA Materials and Processes (M&P) personnel.

4.6 Project Assurance

During the reporting period, Project Assurance continued to update the White Papers for areas of the Shuttle Derived task applicable to the sections that were prepared by S&MA. In addition, PAE continues supporting the Human Rated Launch Vehicle Task. Also, PAE participated in the OSP Lessons Learned final presentation that was held in Florida and which included representatives from Boeing, Lockheed Martin, Orbital Science, JSC, KSC and MSFC. The Lessons Learned presentations will be documented and be made available on Windchill Project link.

Project Assurance assisted in the preparation of the ground rules and assumptions for the new Shuttle Derived task. The task description, schedule and ground rules and assumptions will be presented to Code T at NASA Headquarters for final approval to proceed. PAE also assisted in identifying current Space Shuttle and Space Station S&MA documents for reference to assist in obtaining approval from Code T to establish unique S&MA documents for the Exploration Tasks. In addition, PAE continues supporting the Human Rated Launch Vehicle Task.

Project Assurance is actively supporting the Cargo Tasker of the ETT. The Cargo Tasker includes the Shuttle Derived, Clean Sheet and Expendable Launch Vehicles (ELV) studies. Unlike the earlier Task 5 (Clean Sheet and Shuttle Derived) that PAE finalized and presented to Code T, this tasker involves vertical penetration and decomposition of the reliability predictions in support of the concepts selected for this tasker. PAE is preparing a detailed approach in support of the decomposition effort required.

In support of the various activities in the Cargo Launch Vehicles, Project Assurance continues to perform the following: (1) Clean Sheet Team: Obtained trajectory, performance and description data for three Clean Sheet Launch Vehicles and is working on deriving reliability predictions for these vehicles. In addition, working with the team to define the S&MA required data in support of the various eight (8) defined vehicles; (2) Shuttle Derived Team: Prepared presentation charts for a Technical Exchange

Meeting in Houston to detail the accomplishments and planned activities for the Shuttle Derived and its revised carrier. Presentations are being made in the week of 7/19 – 7/23/04; (3) Expendable Launch Vehicles (ELV): Expressed concerns about the amount of S&MA work needed to be done for the ELV and the time remaining to do. The ELV management had identified the need for performing extensive reliability and safety analyses but there seems to be a disconnect between the Cargo Launch Vehicles team and that of the ELV (a subset of the Cargo Launch Vehicles) and no working groups or meetings have been scheduled yet. This disconnect is being worked out at NASA Headquarters.

Project Assurance participated in the NASA-Industry Technical Interchange Meeting (TIM) held in Houston the week of 7/19/04. In addition to MSFC, the TIM included participants from JSC, KSC, LeRC, Boeing, Lockheed Martin and TK Thiokol. The purpose of the TIM was to exchange data and compare approaches to the work done on the Shuttle Derived Vehicles for Task 5. PAE was selected as the Lead for the S&MA (Reliability) Team that includes membership from NASA and the industry participants. A follow on TIM will be held at MSFC the week of August 10/2004. In addition, PAE continues to pursue analysis on such topics as "Abort to Orbit" and "SSME Benign Engine Shut-down". Finally, continue to work with the Reliability engineers in performing reliability predictions (Loss of Payload and Loss of Mission) on the Shuttle Derived and Clean Sheet Cargo Launch Vehicles.

Project Assurance participated in the NASA-Industry Technical Interchange Meeting (TIM) held at MSFC the week of 8/9/04. In addition to MSFC, the TIM included participants from JSC, KSC, LeRC, Boeing, Lockheed Martin and TK Thiokol. This TIM, TIM #6, was to exchange data and compare approaches and differences to the work done on the Shuttle Derived Vehicles for Task 5. PAE, being the Lead for the NASA/Industry S&MA Team for the Shuttle Derived Launch Vehicle, made a presentation identifying differences and similarities between NASA and the industry's results for the same tasks, and proposed corrective actions to overcome the main source of the differences in future work. Finally, continue to work with the Reliability engineers in performing reliability predictions (Loss of Payload/Loss of Vehicle) on the Shuttle Derived and Clean Sheet Cargo Launch Vehicles.

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Project Assurance completed the Cargo Clean Sheet and Cargo Shuttle Derived charts presented to NASA Headquarters on 09/16/04. The charts reflect the reliability analyses of the various vehicle configurations and highlight the major drivers that contributed to the variances.

Project Assurance supported the Cargo Launch System Team in refining the Cargo Clean Sheet and Cargo Shuttle Derived charts that will be presented to Code T, NASA Headquarters, on 09/20/04. The charts will be a part of a total presentation by the MSFC-led Exploration Team package that reflect the reliability analyses of the various vehicle configurations and highlight the major drivers that contributed to the variances. In addition, PAE took a four-day course in System Engineering for S&MA at MSFC. The course is helpful in that it structurally defined the phases required for successful system engineering. At the end of the class, the participants designed a system that consisted of four robots that operated a delivery system dependant on structure rigidity, interfacing between the robots, functional timing, software for unattended operations and sensors for start and stop functions.

Project Assurance supported the QD12 Office of Exploration Systems Work Breakdown Structure (WBS) tasker by participating in development of the S&MA Code-T Enterprise and Constellation Level WBS. The PSE attended S&MA Meeting in Houston TX on 04/22/04-04/23/04 in order to obtain concurrence from S&MA groups across the NASA centers for the WBS elements. The PSE wrote WBS element language and integrated comments from other NASA centers during the review period after the Houston meeting. The PSE supported subsequent WBS tasker telecons wherein these changes and other comments were integrated into the Office of Exploration WBS elements.

Project Assurance supported the development of a memorandum to establish Quality Assurance measures to enable SD-70 to procure external services for passivation of Orbital Express optical housings via a credit card. The PSE attended HyTex/Orbital Express Weekly Meeting.

Project Assurance supported QD12 in the planning and execution of risk analysis activities for the Launch Vehicle Study Tasker Teams. The PSE attended status meetings of the following launch vehicle study taskers: Cargo, Shuttle Derived Launch Vehicle (SDLV), Clean Sheet Launch Vehicle (CSLV), Crew Launch Vehicle, Integrated Launch Vehicle (Crew/Cargo), Upper Stage, Human Rated Launch Vehicle. The PSE held special risk assessment planning meetings with Crew and Integrated Launch Vehicle (Crew/Cargo) Launch Vehicle teams. The PSE attended numerous meetings with TD-32 planning, and executing the risk activities. The PSE supported Human Rated Launch Vehicle (HRLV) (Crew) Team risk session. The PSE moderated Integrated Launch Vehicle (Crew/Cargo) Team risk session and facilitated risk data entry and Power-Point Slide production. The PSE managed the TD-32 Group who produced numerous power-point risk charts for each of the launch vehicle study teams. The PSE scrubbed charts numerous times to support development of final briefings. The PSE integrated the Cargo Team presentation. The PSE attended various launch vehicle study team and the a number of entire study final chart walk through sessions. The PSE attended risk management meetings with Orbital Express (OE) Team. The PSE attended S&MA Constellation documentation meetings with QD-10 Team.

Project Assurance supported QD12 in the planning and execution of risk analysis activities for the Launch Vehicle Study Tasker Teams. The PSE developed a consensus between John Space Center (JSC), industry and Marshall Space Flight Center (MSFC) launch vehicle study leads on the consequences and likelihood criteria for determining risk exposure. This is critical to provide an apples to apples risk analysis across all these launch vehicle study taskers. The PSE updated the launch vehicle study tasker risk evaluation plan. The PSE developed a matrix to compare differences in risk evaluations performed by JSC, industry and MSFC launch vehicle studies to include April and August differences and comparisons against the ground rules and assumptions. The PSE developed risk evaluation presentations for cargo vehicle's SDLV and Clean Sheet Launch Vehicle (CSLV) Subteam Status Meetings. The PSE attended status meetings of the following launch vehicle study taskers: Cargo, Shuttle Derived Launch Vehicle (SDLV), Clean Sheet Launch Vehicle (CSLV), Integrated Launch Vehicle (Crew/Cargo), Upper Stage, and Human Rated (Crew) Launch Vehicle. The PSE held special risk assessment planning meetings with Crew and Integrated Launch Vehicle (Crew/Cargo) Launch Vehicle teams.

The PSE attended numerous meetings with TD-32, and QD-40 planning, and executing the risk activities. The PSE held a planning session for the Cargo Launch Vehicle team risk session. The PSE produced numerous Power-Point templates to use during the Cargo Team risk session for simultaneously filling out the risk data and building backup charts for the final Cargo Team presentation. The PSE moderated a Cargo Team day-long risk session and facilitated risk data entry and Power-Point slide production. Data Entry was facilitated by the VSTEP risk management tool. Five other facilitators were used to sort through Tasker 5 data which was entered in April, input data into the database, and build Power-Point charts real time. The PSE conducted meeting with TD-32 support staff and produced first draft of Cargo Team risk charts for their final presentation. The PSE attended Cargo Team's (almost day-long) final chart walk through and briefed the risk charts.

Project Assurance held special risk assessment planning meetings with Orbital Express (OE) Team. The team is expected to deliver complete Advanced Video Guidance Sensor (AVGS) software for OE in just a couple of months. The tightness of the schedule and limited availability of the Engineering Development Unit (EDU) and Flight Unit drives the risks associated with this project considerably. Methods were worked out to use both the Space Transportation Information Network (STIN) Risk Management Tools and Excel to Record and Present the Risk Data. STIN is to be used to produce the risk mitigation waterfall charts. The PSE held dry run risk session for OE Team. Many initial risks were entered to get the process going. The PSE moderated three risk sessions for the OE Team, which included Engineering Directorate Lab engineers who are developing the OE AVGS software. The first session included the lab personnel but not the project manager. The second session included the project manager. The third session included the customer and laid the ground work for risk mitigation planning. The next session is intended to wrap up the risk mitigation planning.

Project Assurance supported QD12 by forming a risk management team to support OES Launch Vehicle Study Taskers. This activity included numerous meetings with TD-32, QD-40 and various study tasker leads and personnel. This team was formed out of the necessity to provide both breadth and depth for evaluating risks across all of the launch vehicle studies. This team is also intended to provide an apples to apples risk analysis across all these launch vehicle study taskers. The PSE developed an initial draft of a launch vehicle study tasker risk evaluation plan to use across all of the studies. The PSE developed risk evaluation presentations for the Cargo Vehicle's Shuttle Derived Launch Vehicle (SDLV) and Clean Sheet Launch Vehicle (CSLV) sub-team status meetings. These presentations were based on outputs from the team mentioned above. The PSE developed and submitted risk management schedules to the Integrated (Crew/Cargo) Launch Vehicle Study Tasker Team. These schedules had to be based on outputs from other study teams such as SDLV, CSLV, Human Rated Launch Vehicle, and the Upper Stage team. The PSE attended meetings of the following launch vehicle study taskers: Cargo, SDLV, CSLV, Integrated Launch Vehicle (Crew/Cargo), Upper Stage, Human Rated Launch Vehicle.

Project Assurance supported QD12 by attending the SDLV TIM in Houston TX on 20-22 July 04 for Cargo Launch Vehicle Team Study Tasker and the HRLV TIM in Houston TX on 22 July 04 for Human Rated Vehicle Team Study Tasker. The PSE presented a risk management briefing at the SDLV TIM in Houston Texas on 20 July 04. The PSE took the action on the last day of the SDLV TIM to form a team with the Johnson Space Center (JSC) risk management lead and the industry lead to look at differences in risk management approaches between the activities and to find ways to quantify and normalize these differences.

Project Assurance supported the investigation of a test anomaly on the Aerojet non-toxic, dual mode, Reaction Control Engine (RCE). Test number 134, (25% duty cycle test, 800 pulses) ran full duration but, at shutdown, gox and lox leakage was observed, indicating that the respective propellant valves had been compromised. A review of the data indicated that the engine failed to fully ignite on the initial pulse, leaving residual propellants pooled in the chamber which ignited on the second pulse, resulting in a

pressure spike or "hard start". Aerojet's and the manufacturer's (MOOG) post-test inspections revealed that the ceramic portion of the spark plug had shattered and the OX valve Teflon seat was missing, presumably destroyed and consumed during the test. A detailed look at previous tests revealed slightly reduced pressures which indicate that the ceramic material may have failed prior to test 134 and lodged in critical areas, thereby restricting propellant flows. Failure of the ceramic portion of the spark plug can be attributed to thermal effects of cold OX flow and the dynamic loads associated with previous pulse testing. After a number of potential "fixes" were discussed, the participants agreed that, a five second "lead-in" burn to reach thermal equilibrium will be performed prior to going into the pulse mode. The controller software will also be modified to add an automatic cut should the engine fail to ignite in pulse mode. Although the lead-in burn is not an option under flight conditions, it will eliminate the pooling concerns associated with horizontal testing in ambient conditions and allow the contractor to demonstrate the basic operational capabilities of the RCE. However, this issue will have to be re-addressed prior to vertical testing, in a vacuum environment at White Sands Test Facility (WSTF), scheduled for summer 2005. Additionally, go-no-go criteria, based on changes in applicable pressures, is being developed in order to establish spark plug inspection intervals.

Project Assurance completed a review of the IPD Incident Response Plan which defines the roles and responsibilities of the Air Force, NASA MSFC and NASA SSC in the event of a test incident involving IPD hardware being testing at Stennis Space Center. Although MSFC S&MA has no contractual authority to impose additional requirements on this Air Force managed contract, PAE performed the review at the request of MSFC IPD Project Management. The plan incorporated requirements derived from both military and NASA Specifications including: 1) NPG 8621.1 NASA Mishap Reporting and Investigation Policy; 2) SOI-8080-0020, NASA SSC Test Control; and, 3) SOI-8080-0027, NASA SSC Detailed Operating Procedure. The plan's requirements were compared to those contained in NPG 8621.1 and, with few minor exceptions, deemed comparable. Incident classifications were identical as were the procedures to be followed in the event of an incident/mishap. PAE had previously requested that the document be amended to include the provisions set forth in NPG 8621.1, section 2.5.3 which provide for an exemption to the requirement to convene a formal investigative board provided the conditions set forth in the subject paragraph are met. The latest draft of the IPD Plan contains the requested changes and PAE recommended approval pending acceptance by Stennis S&MA.

Project Assurance represented S&MA at the Aerojet TIM held at MSFC on 08/10/04. The primary purpose of the TIM was to discuss proposed configuration changes to the RCE in preparation for acceptance testing scheduled for early 2005 at the White Sands Test Facility (WSTF). Some of the proposed changes from the Option 1 configuration had been pre-coordinated with MSFC and readily approved. However, one change, increasing the core and coolant fuel orifices in the igniter, raised several technical concerns. Enlarging the orifices would increase the throughput for igniter fuel, allowing it to be trimmed like the Ox side and making it possible for the three engines to be tuned to the same mixture ratio. The resulting chamber pressure (PC) deviations are believed to be insignificant (~5psi) but the proposed increase in the flow split on the fuel side by 1.4% and then orificing to the desired flowrate raised concerns that the injection orifice area increase (factor of two) was excessive. Enlarging the orifice area would reduce injection velocities, potentially impacting ignition characteristics which could, in turn, significantly impact overall performance. S&MA is concerned that significant changes in performance would make it far more difficult to make a valid post-test comparison to engine performance data observed and effectively baselined during Option 1. Aerojet was assigned actions to address the technical concerns and approval of the configuration changes is pending MSFC review of the action item responses.

Project Assurance completed and made the initial submittal of the Crewed Vehicle Reliability Assessment. The package, approximately 25 charts including backup information, contains reliability data submitted by HEI and SAIC Reliability analysts. PAE compiled the data into a format which allowed for

immediate comparison of each engine system's payload capability, mean reliability, and major contributors of each engine to loss of crew/vehicle. Additionally, HEI Reliability analysts performed a comprehensive analysis of loss of crew probabilities and crew escape system effectiveness. Being the initial submittal, the information is subject to revision pending review/comments by members of the special study management team.

ET Project Assurance performed an assessment on the LH2 / Intertank flange joint volume fill candidate materials and provided inputs for a down selection trade study. Volume fill is a mitigation effort against thermal protection system (TPS) cohesive failure resulting in debris. Volume fill will provide a leak barrier between the intertank N2 purge and voids in the foam through various leak paths. The design challenges with volume fill are to develop a volume fill that will perform and not degrade under repeated cryogenic conditions and will not have negative impacts on surrounding hardware. The material and process must be capable of installation into a "blind", confined space. These functional requirements were taken into account in the trade study performed. ET PA will continue to follow the risk mitigation efforts of the volume fill and assure that design and process requirements are properly implemented.

ET Project Assurance reviewed and approved the process validation test plan for the thermal protection system (TPS) manual spray. The manual spray operation is steps 2 and 3 of the enhanced 3-step TPS closeout on the LH2 / Intertank flange being developed for return-to-flight. The new process will reduce the size and number of TPS defects and eliminate the potential for critical debris shedding from the flange region of the ET. This test will verify that the new process yields a repeatable process that will meet engineering requirements of strength and internal TPS voids. ET PA assured that the proper quality requirements were incorporated in the test plan and manufacture of the test articles. ET PA also verified that the test objectives were defined properly to assure compliance to certification requirements. ET PA will monitor and assess the results of testing to determine objective compliance.

ET Project Assurance performed a PFMEA on the enhanced TPS manual spray application for the intertank flange. The enhanced process incorporates increased process controls to assure a higher quality of TPS integrity. The PFMEA will analyze the processing steps by identifying potential process failure modes and associated causes and effects. The controls will be identified and adequacy determined. A relative risk number will be ranked based on probability of failure occurrence, severity, and detection capability. Based on the outputs of the PFMEA, additional controls may be added to the process to reduce risk. ET PA will continue to develop the PFMEA for the manual spray process as well as the other redesign efforts on the ET flange for return to flight.

ET Project Assurance performed an assessment on the LH2 / Intertank flange TPS stringer injection verification. Stringer injection is the 1st step in the new enhanced 3-step application of TPS on the intertank flange. The verification test demonstrated process performance relative to the engineering requirements and verified control of processing parameters. The test also collected data on TPS voids to be compared at a later date analytically to a critical flaw size. ET PA evaluated data from the test and assessed that the verification test objectives were met. ET PA recommended that ET proceed to validation testing for this process. ET PA will continue to flow the validation of the stringer injection process and will assess the test results.

ET Project Assurance performed a risk assessment on the removal of volume fill from the RTF baseline design on the LH2 / Intertank flange. Volume Fill is to be a mitigation effort against cohesive TPS failure and debris on the LH2 / Intertank flange. Volume fill is a material that fills the "y-joint" in the flange region and serves as a barrier for gaseous nitrogen (GN2) through the structural gaps on the bottom half of the flange during the thermal cycles of tanking and will maintain structural integrity during multiple cryo-cycles. Recent testing has indicated process difficulties on a "retrofit" tank where foam blocks these GN2 leak paths. The blocked leak path creates a hydraulic lock on the volume fill material and proper fill

cannot be performed and/or verified. ET PA performed a risk assessment of not performing a volume fill on the RTF retrofit tanks. ET PA concluded that implementation of volume fill on retrofit tanks does not decrease risk in regards to TPS debris. ET PA recommended that issues with gap penetration, interactions between leak rates / void size and structural impacts need to be understood and mitigated. ET PA will continue to provide risk guidance on the enhancement efforts on the LH2 / Intertank flange.

Project Assurance participated in a SSP Quality Panel Process Escape and PA/CA review to SSP Senior Management. The SSP Directive is currently in review to update the Process Escape and PA/CA review process. This review was held to garner feedback from SSP Senior Management on the format and content for future quarterly reviews. The metrics received the most positive feedback; however, there were more metrics in the old format. In addition, the SSP felt the selected special topics were chosen without good logic or without a defined purpose. They were primarily "dated" issues for which they were already well informed. SSP Senior Management struggled with the forum for the review, also. If it was intended to be presented for lessons learned sharing or SSP awareness, the Risk Assessment Program Requirements Control Board would serve as a better forum. SSP Senior Management determined that further defining the content and the purpose of the review might allow for better definition of the audience. Project Assurance will continue to participate in the weekly SSP Quality Panel and provide input to the SSP Directive to address the concerns raised by SSP Senior Management.

Project Assurance attended the Bipod Redesign Delta CDR Pre-Board held on 6/16/04 at the MAF. PAI attended the pre-board with the Quality Directive 20 (QD20) Manager, who was a Pre-Board Member, on the issues concerning the bipod redesign. At the pre-board, Review Item Discrepancies (RID) were discussed for potential closure.

Project Assurance participated in the ET Materials Technical Monitor review held on 08/26/04. The review was held for the Lockheed Martin (LM) Engineering and Technology Laboratories to provide a summary of the work accomplished in relation ET material (design, analysis, detail fabrication, issue resolution, assembly, test, storage, transportation, launch, investigations, audits, etc). As part of the review respective to issue resolution, LM provided a summary of technical issue resolutions and continuing work in progress. Project Assurance requested additional data in regards to engineering rationale supporting disposition of a Senior Material Review Board item for breakthrough of metal on the Composite Nose Cone louver horn. Rationale supported a plan developed for inspection of tanks suspected of the breakthrough condition. However, not all areas of the louver horn are accessible for inspection. Project Assurance requested additional data to assess the rationale for acceptability of those areas not accessible for inspection.

Project Assurance attended and participated in Situational Awareness training held 09/08/04 through 09/10/04 at Marshall Space Flight Center. Situational awareness involves combining an awareness of what is going on in the operations environment, knowledge of system failure design criteria, and an understanding of expected outcomes from system failures to avoid hazardous situations and develop safe responses to unsafe conditions that may be expected. Project Assurance attended and participated in the class to learn basic principles and practices of situational awareness, and established how those practices apply to hazardous operations at Marshall Space Flight Center in order to promote the best proactive safety technique practices within External Tank Safety and Mission Assurance.

Project Assurance supported the monthly SRB team meeting. The analytical review of the 2-D throat model is on going. The latest results indicate that the lower bound on acceptable bondline is 9 mils, down from 10. Current plans call for further review of the 3-D model and further study on the upper limit bound of 27 mils. Testing to validate the updated analysis is under investigation. S&MA suggested pull tests to the throat/bondline. A test plan will be discussed at the next meeting (July 13th). Efforts continue to resolve the two BSM's that were unable to be measured by the capacitance method. Two non-flight

shorted closures have had the exit cones removed and the shorted condition cleared. Further study is underway to more fully understand the reason for this shorted condition. Sectioning is underway of several more non-flight assets to gain more confidence of the capacitance and eddy current NDE methods. The throat extraction method/planning is being developed. Three throats have been extracted from non-flight motors to date and three additional trials are planned for. Detailed inspection (visual, alcohol wipe, x-ray, and physical measurements) will be taken to ensure the throat is in spec prior to reinstallation. The work instruction that details this process is being developed and S&MA will review it after submittal. This non-standard work will be traced through a Vendor Problem Report (VPR) with all work instructions and data attached. To date, there are three throats that will require extraction from an existing assembly and reinstalled into flight motors. Cork and paint removal to convert an aft BSM to a fwd BSM is under review. S&MA review and submitted comments to this work instruction, B12000-16-03-510. Currently, no BSM's have undergone this cork removal process and no motors have been sent to KSC for a fit check. Rationale for the aft BSM Factor Of Safety (FOS) waiver has been released. The major rationale points cover no performance impact due to a crack; no overpressure possible due to a liberated particle blocking the throat; and no credible burn-through due to crack. The Debris Transport Analysis will not be available until September 14, 2004. All preliminary results show a trajectory that will not contact the Space Shuttle or External Tank. The current plan is to take the waiver chart package to Level IV next week to start the detailed coordination with the community as to rationale.

Project Assurance supported the SRB monthly Team meeting where, ATK's liner and vulcanization processing status was reviewed. An update to the propellant development was also reviewed. No major concerns. A facility issue was raised concerning a problem with the conductive floor. The top layer treatment did not adhere properly and is chipping away. ATK is determining the root cause and will resolve this issue in August. The throat material down select timing has been extended to November, 2004. The throat parallel path will continue. Throat testing criteria has been reviewed by S&MA and comments delivered to the team. The next meeting is July 13.

Project Assurance represented QD20 during a BSM Delta Phase III Review conducted July 20th to 23rd at Pratt & Whitney (P&W) Space Propulsion Operations, San Jose, CA. The Phase III Review team consisted of representatives from United Space Alliance (USA), Vendor Quality Engineering and MSFC TD51. The scope of the review was to inspect and conduct data review for 16 Lot ABS forward motors and 16 Lot ABR aft motors. The review was designated as a Delta Phase Review to the original Phase Review conducted in December, which covered all documentation produced by original Lot ABS and ABR production. Additional processing included igniter installation, set screw repair, and bondline evaluation. During the Phase III review, the 16 Lot ABR aft motors were taken off the table due to Program Management decision to perform bondline evaluation on all aft motors. The team conducted planned Phase III physical inspections of the deliverable BSM's and reviewed the production documentation. The 16 Lot ABS forward BSM's are planned for open-work shipment to KSC. Open work yet to be finalized includes Certificate of Qualification approval, Phase III Lot Certification approval, Lot Acceptance Test Firings, Qualification Testing, closure of open Review Item Discrepancies from the Igniter Redesign Critical Design Review, Level V Change Review Board design documentation approval, open Material Usage Agreements, and open P&W and USA nonconformance documentation.

Project Assurance supported the monthly SRB Team meetings. There were three major areas of focus, Analysis, Non Destructive Evaluation (NDE) development, and throat replacement. Preliminary analysis shows bondlines from 9 to 32 mils will provide a minimal 1.4 Factor Of Safety (FOS). The Debris Transport Analysis (DTA) is still ongoing. The DTA is evaluating the post-SRB separation times at 0.7, 0.75, 1.0 and 1.5 seconds. Work on the Risk Analysis also continues. The NDE process (Capacitance and Eddy Current) for bondline assessment is finalized, but the data reduction from Eddy Current technique is challenged due to inherent variability in assemblies. Efforts are still ongoing to calibrate the Eddy Current technique. All aft BSM's will undergo this bondline assessment, which requires additional

disassembly work. The throat replacement team is further developing the throat replacement procedures. Three additional "push-out" tests will be performed with improved pre-test and post-test data taken. The aft BSM FOS waiver presentation was presented to MSFC Level IV/III boards. This presentation provided information to the board members and discussed history, waiver rationale and various supporting material. The next meeting is August 3rd.

Project Assurance supported the SRB 120 F Carbon Cloth Phenolic throat test. Although the ballistics data looked good, pitting / pocketing occurred in the throat. From it's appearance, debris was liberated over the acceptable level. The next Carbon Cloth Phenolic throat test is scheduled for July 30th. Bubbles were also reported in the dome area of the motor liner. All motors lined to date have shown bubbles in this area and to date, all efforts to eliminate this situation have been unsuccessful. Effort is ongoing. The Nozzle and Loads Analysis Technical Interchange Meeting (TIM) agenda was agreed upon and a date set for August 11-13. The next meeting is August 5th.

Project Assurance participated in a Failure Investigation of S/N 200067 SMFIV. In July, the valve exhibited significant leakage (approximately 300cc/min) during initial Acceptance Check Out testing of BI124 (STS-124) Right, Aft Skirt TVC System. Valve was subsequently removed and returned to manufacturer (Moog) for teardown. Teardown revealed metallic particulate contamination (approximately 25 particles on inner land identified by SEM evaluation as Aluminum Oxide with some Titanium) on the Teflon valve seat and localized surface corrosion on coil housing. Titanium is parent material of the valve manifold and test fittings, but the source of the Aluminum Oxide is unknown at this time (however, visual appearance implies a possible abrasive, potentially from lapping paper utilized at FI-Ops.) Failure investigation team is in-place and investigation is continuing.

Project Assurance engineers taught the CRM Executive Overview course to ISS Payloads Furnace group: The 15 class participants were all members of the same project and expressed a keen interest in CRM. The group was all experienced with CRM to some degree and used the ePORT database to track, document and mitigate their risks. The class was a success overall, and it was stressed that the CRM is available for further training of team personnel as well as assessing their risk process.

Project Assurance performed testing on IRMA 5.0 prior to acceptance by OSP: Futron delivered IRMA 5.0 as the final product to the OSP program. As part of the delivery process, in depth testing was performed on the database to ensure all requirements were met. The requirements that were not met were reviewed, troubleshot and repaired. All OSP risk data from IRMA 4.3 was successfully transferred to IRMA 5.0.

Project Assurance finalized updates to OSP Risk Management Plan Revision A: The OSP Risk Management Plan was update to include the following appendices: OSP Risk Summary Card, OSP Risk Work Instruction, IRMA Users' Guide, IRMA Earned Value Management Process and Probabilistic Risk Assessment (PRA) Overview. The concept was to have the OSP Risk Management Plan be signed by OSP management out of board, but that path was cancelled. The plan will still be revised as a draft and then archived. The plan can then be used a risk management plan template for other NASA programs.

Project Assurance engineers attended Process Based Mission Assurance (PBMA) Training: The NASA Office of Safety & Mission Assurance sponsored a training session on NASA's newest collaborative engineering tool Process Based Mission Assurance (PBMA). This training included: familiarization with PBMA key features including: Secure Work Groups, Secure Meetings, Knowledge Registry, web collaboration and joint documentation editing and scheduling. This tool is very powerful for working groups and establishing a web-based work effort for any size project. On-line discussions can be held and work processes/procedures can be brought together in real time for all parties to buy into. If implemented properly, this tool can reduce a lot of mis-managed meeting time.

Project Assurance engineers attended Foundations of Risk Management Training: The CRM course developers from Risk Management Corp. presented their course new material for review and critique. There is a NASA wide effort to re-accomplish risk management training throughout the agency and the MSFC CRM group was the first to review the course material. A marked change of approach was the emphasis on individual decision-making and how it could lead to the development of a risk situation. This puts the emphasis of "thinking risks" on all members of a project or program. This thought process will be incorporated throughout the other five risk management courses, currently under revision.

Project Assurance coordinated and assisted in conducting Shuttle Continuous Risk Management Training and Shuttle Integrated Risk Management Application (SIRMA) for Marshall SFC Shuttle support personnel: This training effort was originally requested by Marshall SFC CRM office to train the Shuttle support personnel located at Marshall. The purpose of this training was to review CRM and present the Shuttle Risk Management Application (SIRMA) to the Shuttle work force. The instructors were flown in from Johnson Space Center and conducted two, one day classes. This effort was coordinated with Dr. John V. Turner (NASA), the Shuttle Risk Manager.

Project Assurance supported Jupiter Icy Moons Orbiter (JIMO) risk management identification, process development and documentation effort: Supported the initial effort in identifying Gimbal risks that have been documented in the Value Stream requirements process. The risks were then transferred to a spreadsheet for importing into the Active Risk Manager (ARM) database. However, getting access to ARM proved impossible because the only version that NASA has access to is located at Stennis Space Center and data security issues prevented entering the data. A temporary process was to export the data into an excel spreadsheet and then translate the data into a PowerPoint presentation template that was loosely based on the Orbital Space Plane (OSP) IRMA generated monthly risk presentation. The main issue with this process is that the original spreadsheet did not provide all the risk data and therefore the charts suffered from accuracy. International Space Systems Incorporated (ISSI) provided the original data spreadsheet.

Project Assurance supported Office of Exploration risk identification and documentation effort: Supported the Office of Exploration risk identification by submitting a variation of the OSP risk summary card to aid in the proper identification of the likelihood, consequence and timeframe of all risks.

Project Assurance assisted in the development Continuous Risk Management Story Board to present at symposiums and colloquiums: The Marshall SFC Office of Safety & Mission Assurance asked that a promotional story is put together to help advertise the CRM process. This product will result in a three pane screen and self enclosed for ease of transport. The content of the screens identify the key factors of CRM and how it should be accomplished and implemented in all NASA sponsored MSFC projects and program.

Project Assurance attended Active Risk Management (ARM) training in order to support NASA Office of Exploration risk management effort: The Active Risk Management course was taught at Stennis Space Center, MS by the Strategic Thought trainer. The purpose of this training is to address the NASA Office of Exploration effort to consolidate and control all risk management through the ARM database and to make ARM a one NASA risk management tool. MSFC has been tasked to research various launch vehicles and the risks associated with the vehicles, operations and crew/cargo issues. The CRM process and the ARM database will be used to support this risk identification to support the Office of Exploration effort and so the ARM training will provide risk database expertise to this effort.

4.7 Risk Management and Risk Assessment

4.7.1 Risk Management

HEI Project Assurance (PA) Continuous Risk Management (CRM) provided one half day of CRM training and risk identification workshop to the Next Generation Launch Technology Program Integrated Powerhead Demonstrator (IPD) Project. There were 9 participants from the IPD project and one from HEI. The participants were introduced to the CRM practice with an emphasis on capturing and writing good risk statements.

HEI PA attended Continuous Risk Management training at Goddard Space Center as first step in getting certified as CRM instructor-(12/15/03 - 12/19/03). This course was later dissolved and the training was voided because the contractor charged to perform the training was asked by NASA HQ the Safety and Mission Assurance office to rewrite the course. Instructor certification would resume after the course was accepted by NASA HQ, the Safety and Mission Assurance office.

HEI PA proposed that S&MA acquire the services of expert consultants in the area of cost and schedule risk to build MSFC Center capabilities in these key risk areas. PA identified and coordinated the services of the national renowned cost and schedule risk expert, Dr. David Hulett to present the theory and practice of quantitative cost and schedule risk analysis. These consultations were held at the Marshall Institute and were attended by Center cost, schedule and risk management personnel from Orbital Space Plane, X-37, Chief Financial Office, and Safety and Mission Assurance. OSP has expressed an interest in bringing Dr. Hulett back to provide specific program support in quantitative cost and schedule risk analysis and integration.

HEI PA CRM presented the IRMA Monthly Metrics reports were presented to the OSP Program Manager and staff at the December Program Review. The OSP program manager and staff reviewed the eleven Top Program Risks (TPRs) with no changes or updates to the mitigation tasks or risk documentation. The OSP Monthly Risk Review requires the development and implementation of an OSP process flow and documentation to ensure that the OSP Program management team and all OSP personnel address the mitigation and tracking of all significant risks and TPRs.

HEI PA CRM has developed an interactive Continuous Risk Management internet site for Marshall Space Flight Center.

HEI PA CRM provided support to QS01/R. R. Malone (NASA) in defining a Risk Management Process for the NASA Engineering and Safety Center (NESC) and use of the OSP Integrated Risk Management Application (IRMA) software.

HEI PA CRM provided one half day of Continuous Risk Management training to the Lockheed Martin OSP team in Denver. There were 23 participants from Lockheed Martin and Orbital Sciences Corporation. Twelve were in the classroom with the remaining eleven tied in via teleconference. The participants were introduced to the CRM practice with an emphasis on capturing risk statements.

HEI PA CRM provided one half day of Continuous Risk Management training to the OSP Boeing initiative team at the Marshall Institute. The participants were introduced to the CRM practice with an emphasis on capturing risk statements. The participants were also giving a half-day of training on the Integrated Risk Management Application.

HEI PA CRM is currently working enhancements to OSP Risk Management Plan to include Appendix A, OSP Risk Management Summary Card and related material; developing a web based training handout for the OSP Integrated Risk Management Application (IRMA) database; and scheduled a training date for the

NASA required Train the Trainer course, which allows Risk Management to develop CRM lesson plans and conduct CRM training, as per NASA requirements.

HEI PA CRM OSP Risk Management attended Operational Readiness Review for the release of the OSP Integrated Risk Management Application (IRMA). ORR reviewed the application and decided that it should not be released to the program based on the following issues: 1) Non-compliant with 508 requirements, 2) IRMA database did not provide the capability to generate reports to Macintosh computers, 3) IRMA data security and export control issues needed to be more stringently addressed by the application and, 4) NASA Logo graphic constraints were not adhered to. The ORR findings provided no feedback to correct the findings. The ORR did not allow for the application of a waiver to release IRMA to the OSP for implementation into the OSP risk management process. OPS Information Technology (IT) management is reviewing the limited instructions on providing information in order to conduct a successful ORR.

HEI PA CRM provided a variety of CRM classes tailored to the needs of each project or initiative. Tailoring allows the projects to receive maximum benefit from the class. PAE has provided two-hour overviews, one half-day classes, full two-day classes and CRM overviews with follow-on risk identification and analysis workshops to projects and also provided instruction in CRM as part of the MSFC Center initiative Project Planning and Control series.

HEI PA CRM participated in the Center Risk Management Capability to Perform Assessment as a member of the control team. PAE worked with the team to develop assessment criteria, and participated in the project interview process that will lead to an assessment of the Center's capability to perform risk management. HEI hired a subcontractor to facilitate the assessment. The results of the assessment process have been analyzed and summarized for Center management and have been presented to the Center Director. As a result, S&MA has an expanded role in CRM implementation across the Center. To support this new role, CRM has been researching tools and techniques for analyzing risk to provide additional value to the products provided to our customers and stakeholders. Particular emphasis has been placed on acquiring tools to better analyze risk associated with cost and schedule. An example of innovations in the future will be the use of Monte Carlo simulations in analyzing schedule and cost risks.

HEI PA CRM has been consulting with projects and assisting with development of risk management plans and strategies. Programs supported include the OSP Program, Space Shuttle Environmental Assurance (SEA), and NGLT. In a quick turnaround action, PAE was asked to review a SSP change request (CR) that would incorporate the continuous risk management process into the Shuttle Program. The CR was reviewed and PAE immediately attended a teleconference with the Shuttle Program Safety Director. PAE provided timely information to the Safety Director about the status of the Integrated Risk Management Application (IRMA) that was proposed by the CR. IRMA is currently being upgraded by the OSP program to address security issues that the Shuttle program was not aware of.

HEI PA CRM provided one half day of Continuous Risk Management (CRM) training to the SPD Project. There were 10 participants in the class and additional students were tied in via teleconference from a number of universities around the country. The participants were introduced to the CRM practice with an emphasis on capturing risk statements.

HEI PA CRM provided a one half day presentation of CRM with a risk writing workshop to the g-LIMIT Project. There were 9 participants in the class. The participants were introduced to the CRM practice with an emphasis on capturing risk statements. During the workshop PA worked with the team they examined the risks of the project that have already been captured in the ePORT risk reporting databases and clarified the risk statements and mitigation strategies and reassessed the likelihood and consequence of

the risk. A follow-on workshop is planned to go through the risk identification process again as the program enters its final stages.

HEI PA CRM developed a risk closure process to support the closeout of risks documented in the OSP program risk data-base. PAE is working to assist the program in capturing lessons learned over the life of the program and document those lessons in the database.

HEI PA CRM developed a draft version of the Integrated Risk Management Application (IRMA) Users handbook. This was developed to address CRM training needs. The effort was initially undertaken prior to the shutdown of the OSP program and was seen as another training tool that would be beneficial to the OSP CRM training effort. It will also benefit the user needs of the other potential users of the IRMA tool.

HEI PA CRM IRMA development team has developed an IRMA Administrator's Guide for database administrators. The review included: the process for establishing user identification and password generation, program/project hierarchy and tier structure, data error reporting, graphical representation of risks and risk data reports unique to the project or program. Process flow and documentation errors were noted and suggested corrections were annotated to the document and then forwarded to the IRMA database developer.

HEI PA CRM has been tasked by MSFC QD40 to establish a better understanding of available CRM tools. This includes an electronic Project Online Reporting Tool (ePORT) database training overview that was provided by the MSFC SMO office to CRM. This overview provided insight and understanding on using the ePORT tool to support the CRM education effort for small and medium projects located at MSFC.

HEI PA CRM provided an executive overview to a generic group of project leads and engineers working at Marshall on NASA projects and programs. This course provided a snapshot of CRM process to senior engineers and project managers.

HEI PA CRM coordinated with the OSP Program Planning and Control Office to donate risk management tools and resources (software, equipment and personnel) to S&MA/QS-40 to support the CRM effort. The IRMA tool was offered to aid in the implementation of the CRM process in data collection and documentation. S&MA/QD40 agreed to accept the resources and review the implementation of IRMA as a CRM tool.

HEI PA CRM developed a promotional display to advertise and support the Marshall directive on promoting CRM in all projects, the CRM group has developed a promotional flyer that will promote CRM training through out the Marshall Space Flight Center. This flyer will be published and distributed through out the center as a promotional/educational tool on how access CRM training for MSFC NASA programs and projects.

HEI PA CRM provided IRMA database training to fifty percent of the S&MA/QD40 CRM group. The training illustrated the connectivity between the CRM process and the IRMA data structure. Emphasis was placed on the availability of the database, its online help function and the ease of report generation.

HEI PA CRM NASA reviewed a NASA Safety and Mission Assurance directive that states that clarifies the development of all risk statements. Risk statements will no longer be tied to an "if – then" definition, preventing the risk developer/owner from "going down the wrong path" of defining a risk statement. This change in thought process illustrates a more structured risk definition process and allows for the development of a more structured risk statement process. Current CRM instructional material will be modified to implement the new risk statement development process.

HEI PA CRM for RM provided a one half day presentation of CRM for the subject project with a follow on risk identification workshop scheduled. There were 3 participants locally in the class held at the Marshall Institute and 3 participating by teleconference at JSC, Goddard and Ames. The participants were introduced to the CRM practice with an emphasis on capturing risk statements.

HEI PA CRM brochure was developed at the request of QD40. Its purpose is to promote CRM and the capabilities of the CRM support team to include: CRM training, assistance in developing risk management plans, risks lists and risk mitigation plans.

HEI PA CRM developed an integrated CRM/ePORT training course for all the ISP key project personnel. It incorporated CRM theory as well an overview access to the ePORT database, data entry and sample reports.

HEI PA CRM aided the Next Generation Launch Vehicle Technology research effort in identifying risks associated with twenty-two variants of launch vehicles. This effort aided the NASA Office of Exploration in identifying and documenting risks associated with current launch vehicles, shuttle based launch vehicles, next generation rocket motors and launch vehicle support structure. This was the first time that the CRM group was asked to support a research effort. The results are still in review but the risks that have been identified will be used to determine the next generation launch vehicles in support of the Presidential Station, Moon and Mars effort.

HEI PA CRM received a training overview on the Active Risk Manager (ARM) database tool at Stennis Space Center, MS. This risk database was used successfully on the DoD's Joint Strike Fighter program and has been identified as the risk database tool of choice for NASA's Office of Exploration. Additional training was conducted; however, the delayed acquisition of software site licenses has prevented the full implementation of ARM into Office of Exploration programs here at MSFC.

HEI PA CRM (T. Wrigley) has been tasked to author and present a paper on incorporating Earned Value Management (EVM) processes into the CRM process. This paper will illustrate the links between EVM and CRM to identify, document and reduce cost and schedule risks in any project/program. This paper will be presented at the Continuous Risk Management Symposium at Glenn Research Center, Cleveland, OH.

HEI PA CRM aided the Jupiter Icy Moon Orbiter (JIMO) project in identifying and documenting risks. This effort included coordination with California Institute of Technology Jet Propulsion Laboratory on implementing CRM early in the project and using the Active Risk Manager (ARM) database tool to document all JIMO risks.

4.7.2 Space Shuttle Probabilistic Risk Assessment (PRA)

HEI RA Work continues with the Overarching model and Naming Scheme PRA teams as well as with SRB-ORB APU PRA team in order to formulate strategies for implementing the IPR comments into the PRA Fault Tree and PRA methodology.

HEI RA PRA prepared analysis results, a presentation, and presented the results to the IPRP on 05/13/04 during the 'Shuttle Probabilistic Risk Assessment' (SPRA) Database meeting in Rockville, MD. The analysis compared four methods for developing composite generic prior distributions for functional failures.

HEI RA PRA attended the SPRA Database meeting with the IPRP in Rockville, MD on 05/13/04 – 05/14/04 to review MX and NC briefing on “SSP PRA Buy-in”. A follow up meeting was held with the NASA MSFC PRA Shuttle Lead to review and discuss results of SPRA Database meeting.

HEI RA worked with SSME PRA team and HQ Code Q on implementing the recommended the failure data discount methodology using Excel spreadsheet, and started putting together a draft paper on the revised methodology.

HEI RA PRA developed and delivered a listing of ET basic event names and failure modes to JSC in order to support the development of basic event naming schemes. Data analysis results were also developed in support of the Data Analysis team; responsible for developing methodology and documentation for Shuttle PRA baseline.

HEI RA Work on performing sensitivity analysis has begun on selected SSME major components and discussions with the SSP PRA schedules as well as modeling issues discussed with the SSP PRA technical manger.

HEI RA Attended weekly Shuttle PRA telecon. A list of SRB basic event names and descriptions to determine the use of naming abbreviations was compiled; comparison tables to compare SRB and ORB APU failure rates have been developed; The Shuttle PRA data analysis meeting in Washington D.C. was represented along with the IPR. Sensitivity analyses have been performed on some of the SRB APU leakages using new methodology.

4.7.3 Reliability Prediction & Risk Analysis

A Gauge Repeatability and Reproducibility (R&R) study, requested by Risk Assessment (RA), was performed on new ETAR portable hardness detectors. The devices were found to be very capable when measuring hardness on calibration tiles and little variability was found due to and between operators. Discussions are ongoing regarding fracture toughness data. RA has supplied an answer on number of samples required to reach a 99% prediction limit with 95% confidence (and other values).

4.7.4 OSP Risk Assessment

Risk Assessment (RA) reviewed the IRMA Administrator's Guide for accuracy of content and implementation among the IRMA community.

5.0 COST REDUCTION ITEMS

Our continuing cross-utilization of employees, continuous analysis of work in progress to assure that application of resources meets the needs of the task, and the judicious acquisition and distribution of tools to enhance the efficiency of all team members allow us to minimize cost to the customer.